BIOLOGICAL ASSESSMENT FOR ENDANGERED, THREATENED, AND CANDIDATE SPECIES

INTERIM SOUTH DELTA PROGRAM

U.S. Bureau of Reclamation
Mid-Pacific Region

and

State of California
Department of Water Resources

Prepared By:
Miriam Green Associates

December 1995

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Prepared for:

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I. INTRODUCTION

Purpose of the Biological Assessment

This Biological Assessment for the U.S Bureau of Reclamation's (USBR) and Department of Water Resources' (DWR) Interim South Delta Program (ISDP) has been prepared pursuant to Section 7 of the federal Endangered Species Act of 1973 (16 USC 1536). This document also will be submitted to the California Department of Fish and Game (DFG) as part of the USBR's and DWR's consultation under the California Endangered Species Act. A separate Biological Assessment is being prepared for fisheries; this document addresses only terrestrial resources, i.e., plants and wildlife.

The USBR and DWR have determined that the Proposed Project may affect the Swainson's hawk, western pond turtle, great blue heron, Delta tule pea, brittlescale, Mason's lilaeopsis, and rose-mallow. The Swainson's hawk is designated as threatened by DFG. The western pond turtle is designated as a Category 2 candidate species by the U.S. Fish and Wildlife Service (USFWS) and as a Species of Special Concern by DFG. The great blue heron is designated by DFG as a Species of Special Concern. Delta tule pea, brittlescale, and Mason's lilaeopsis are designated as Category 2 candidates by the USFWS, while rose-mallow is designated as a Category 3b species. Mason's lilaeopsis is also classified as rare by DFG. Suitable habitat for the giant garter snake, a state- and federally-designated threatened species was found in the ISDP area; however, no individuals of this secretive species were documented during field surveys which included a live-trapping program. Suitable habitat, i.e., elderberry, was also located for the federally threatened valley elderberry longhorn beetle; however, no evidence of the beetle was found.

This Biological Assessment summarizes the results of field surveys within the ISDP area; evaluates listed, proposed, and candidate plant and wildlife species that could be affected by the ISDP; and evaluates the extent of impacts on species to determine whether the Proposed Project is likely to be detrimental to the continued existence of those species. An analysis of potential impacts of eight alternatives being considered is also included. Mitigation measures have been recommended to avoid or minimize impacts on special-status species.

Background Information

Prior to conducting field surveys for the ISDP, considerable research was undertaken on federally-designated threatened, endangered, proposed, and candidate plant and animal species; state-listed rare, threatened, and endangered plant and animal species and California wildlife species of special concern; and plants of concern to the California Native Plant Society (CNPS) which could occur in the geographic area affected by the Proposed Project. A master list of 101 species that could potentially be affected by the ISDP was compiled from separate lists prepared by the USFWS and DFG. Written accounts describing the legal status, distribution, habitat requirements, critical habitat, and reasons for decline were then prepared for each special-status plant and animal species. Individual range maps were also prepared based on known occurrences from published literature as well as information obtained from the California Natural Diversity Data Base. This information is contained in the Phase I Report on Sensitive Species for the Interim South Delta Project (Miriam

Green Associates [MGA] 1993) and is hereby incorporated into this Biological Assessment by reference. Copies of this report are available from both the USBR and DWR offices in Sacramento.

Instead of repeating lengthy narratives contained in the above report, this Biological Assessment focuses on those species that have been confirmed to occur in the ISDP area from field surveys. Although summary tables of special-status species determined not to be in the ISDP area are included in this Biological Assessment, the reader is referred to the Phase I Report (MGA 1993) for more detailed information on individual species.

II. THE PROPOSED PROJECT/ACTION

Introduction

This chapter contains a description of the proposed project or action, including a detailed discussion of the effects of the proposed operation upon the hydrodynamics of the Sacramento/San Joaquin River Delta. The Proposed Project, and each of its five components are described first, followed by pertinent information regarding the State Water Project (SWP). SWP facilities are mapped in Figure II-1.

Interim South Delta Program

The Interim South Delta Program (ISDP) is a proposed action to: 1) settle pending litigation against the USBR and DWR; 2) implement an element of the Central Valley Project Improvement Act; and, 3) enhance the existing water delivery capability of the SWP. The ISDP includes five project components: 1) the construction and operation of a new intake structure at the SWP Clifton Court Forebay; 2) channel dredging along a reach of Old River just north of Clifton Court Forebay; 3) the construction and operation of a barrier seasonally in both the spring and fall to improve fishery conditions for salmon migrating along the San Joaquin River; 4) the construction and operation of three flow control structures to improve existing water level and circulation patterns for agricultural users in the south Delta; and 5) increasing diversions into Clifton Court Forebay up to a maximum of 20,430 acre-feet per day on a monthly averaged basis. Each of these five components is discussed below. Facilities proposed under the ISDP are shown on Figure II-2.

Component 1: Construct and Operate a New Intake Structure at the SWP Clifton Court Forebay

A new intake would be constructed at the Clifton Court Forebay and would be operated to complement the operation of the existing intake structure. Both of these intakes would be necessary to utilize the full pumping capability of the existing pump units at the Harvey O. Banks Pumping Plant under the variety of possible physical conditions in the Delta. Both intakes would be operated to allow water to enter the forebay when the water level in Old River is higher, and to prevent water from flowing out of the forebay when the water level in Old River is lower. The remainder of this section provides additional information about the proposed new intake.

The proposed intake would include a 200-foot by 60-foot by 28-foot concrete structure with six steel radial gates, each 30 feet wide by 29 feet high (Figure II-3). The structure would be located within the Clifton Court Forebay embankment. A cellular cofferdam approximately 1,100 feet long would surround the west side of the structure in order to construct the intake in the dry. An equipment storage pad 200 feet by 200 feet would be located adjacent to the concrete structure.

Approximately 2,600 linear feet of new levee sections would be constructed from West Canal to the Clifton Court Forebay. The trapezoidal channel would have 3 feet horizontal to one foot vertical side slopes.

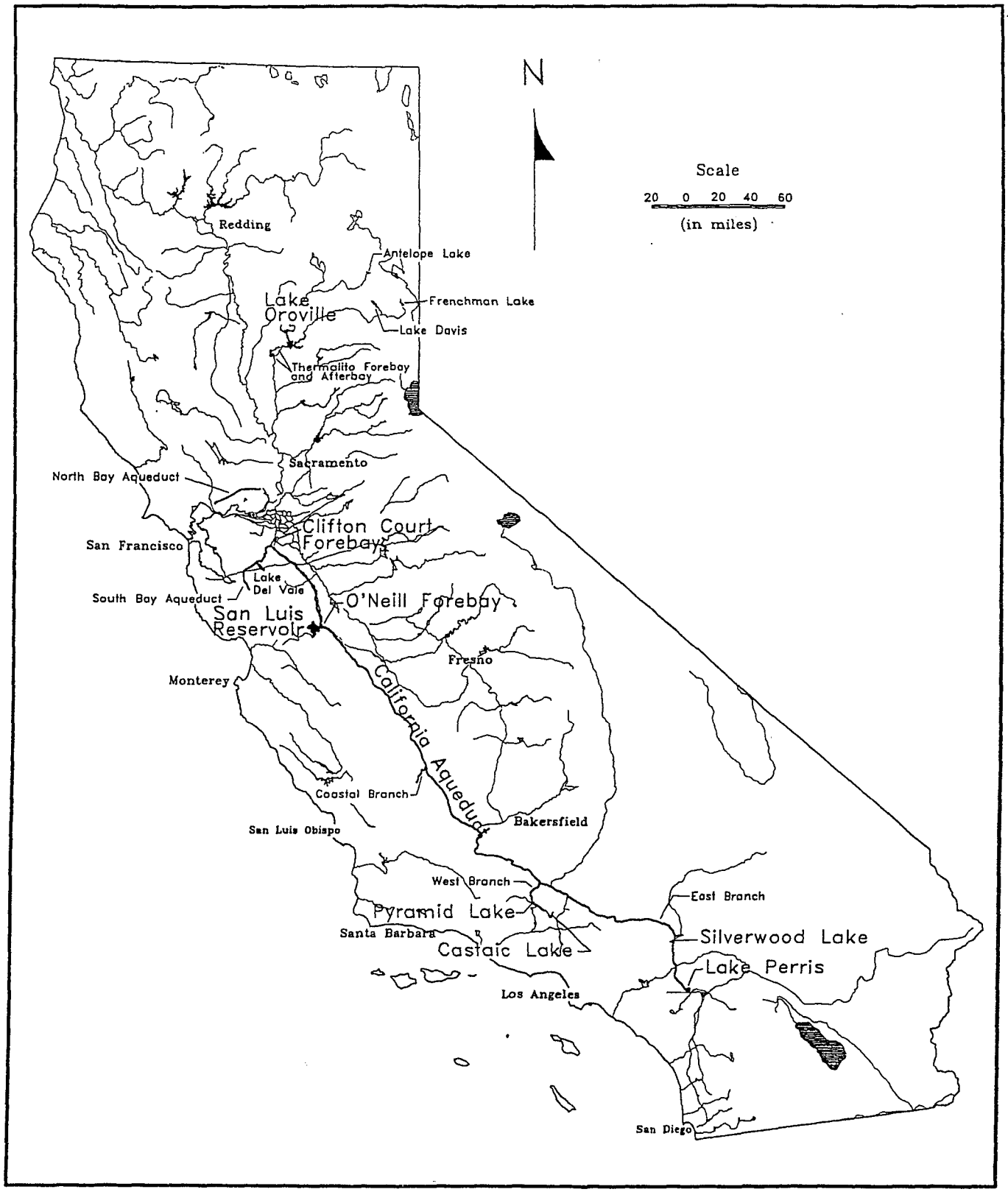

Figure II-1. State Water Project (SWP) Facilities

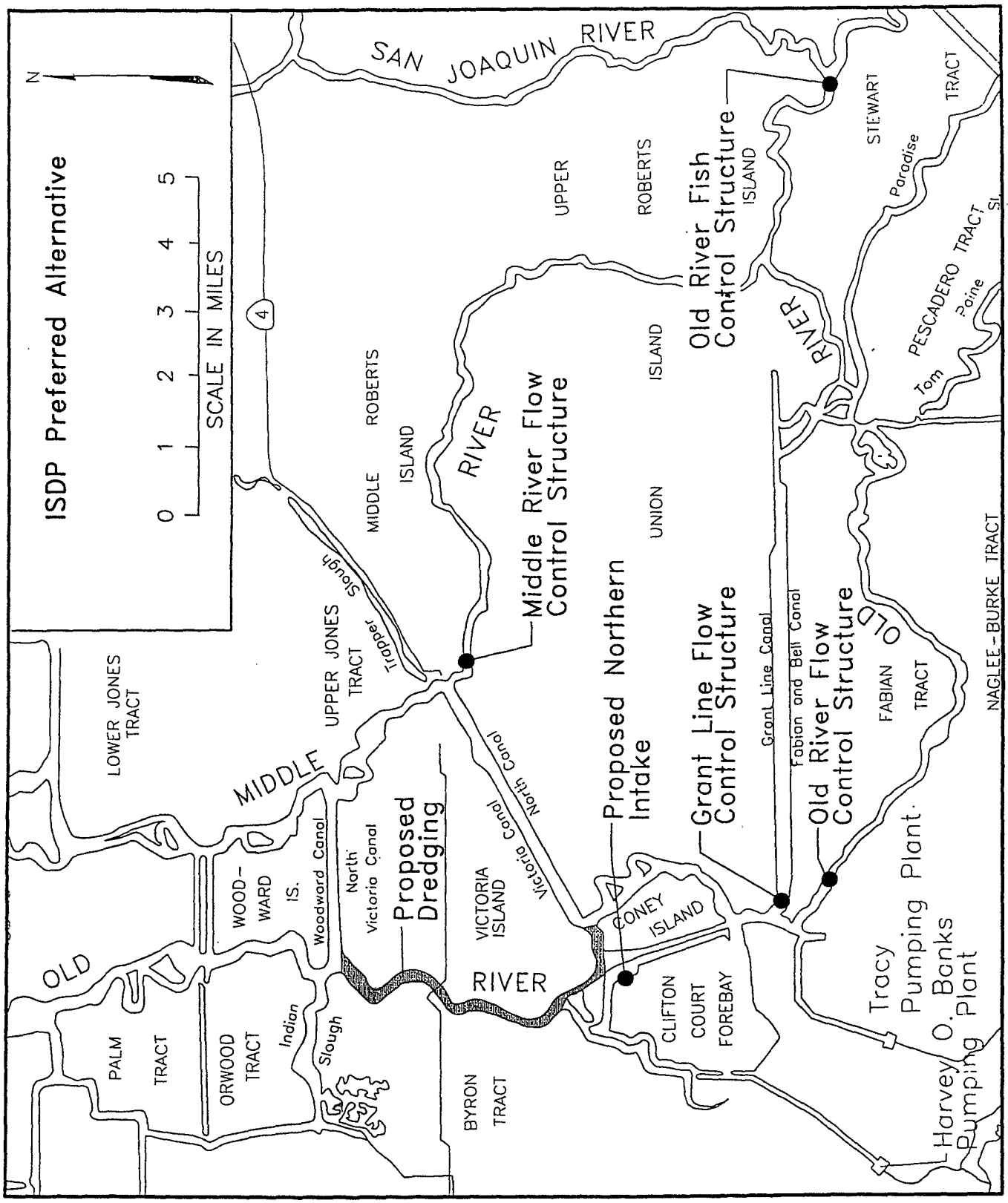

Figure II-2. Interim South Delta Program Facilities

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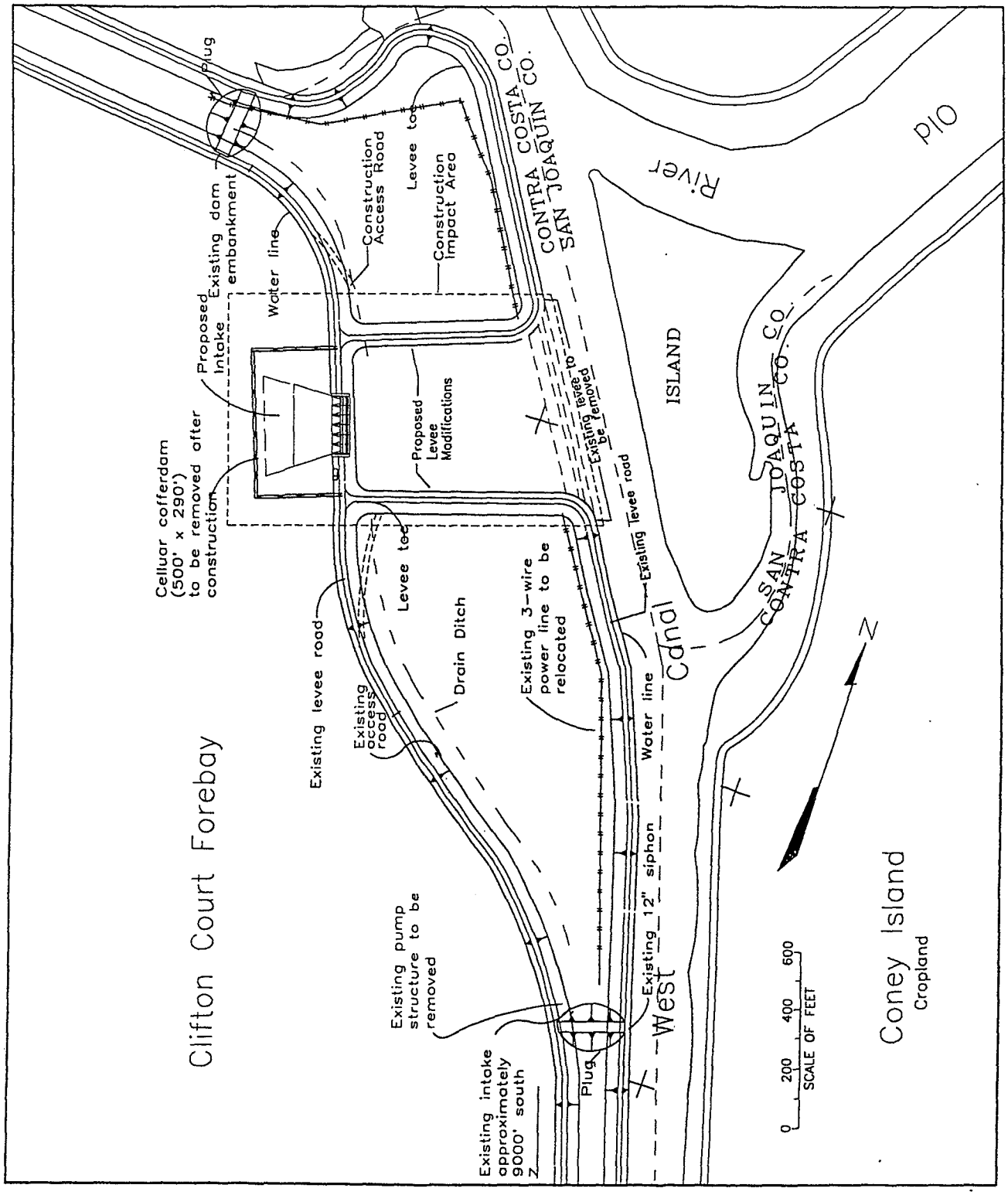

Figure II-3. Proposed Northern Intake

Approximately 320,000 cubic yards (cy) of sand, gravel, and rock would be required to construct the combined new levees and equipment storage area. Filled areas would be to an elevation of 14 feet with side slopes of 2 feet horizontal to one foot vertical. The entrance channel and exit channel would be protected with rock riprap.

The new intake structure would be similar to the existing intake structure in configuration and operation. It would be operated either simultaneously with or independent of the existing intake, depending on the amount of water to be diverted into the forebay, specific tidal conditions, water quality, or other factors. The radial gates would be closed when the water level outside of the forebay recedes to retain water in the forebay. Based on detailed modeling results conducted to date, the additional intake could divert a peak flow of 30,000 cubic feet per second (cfs) during the flood tide and an average flow over the tidal cycle of about 10,000 cfs.

The construction period would last approximately 36 months with a construction crew of about 100 persons. The estimated cost of the new intake facility is $13.6 million.

Component 2: Perform Channel Dredging along a Reach of Old River just North of Clifton Court Forebay

The physical testing and modeling carried out for the ISDP showed that the dredging of Old River, from the Western Canal to the confluence of Old River and North Victoria Canal, is necessary to allow the full pumping capability of the Banks Pumping Plant, while avoiding sediment movement and scouring during peak diversion periods (Figure II-4). The dredged material would be dried on Victoria Island and then used for levee reinforcement along Victoria Island and Byron Tract. The following paragraphs provide a more detailed description of these actions.

Approximately 1.25 million cy of material would be dredged from a 4.9-mile reach of Old River to increase the channel capacity north of the new intake. The existing channel would be dredged to increase the average channel depth no greater than 5 feet below the existing channel bed. The potential for levee instability would be alleviated through the adherence to the following design criteria: limiting removal of material to the center two-thirds of the width of the existing channel, maintaining a minimum side slope of 2:1 along the new cross sections, and designing a series of benches for the new cross section.

Given the extremely limited amount of geologic data on the existing channel bottom, the use of a cutterhead suction dredge is anticipated. The hydraulic pipeline cutterhead suction dredge is the most commonly used type of dredging vessel and is considered to be the most efficient and versatile. Because it is equipped with a rotating cutter apparatus surrounding the intake end of the suction pipe, it can efficiently dig and pump all types of alluvial materials and compacted deposits, such as clay and hardpan. Silt curtains can be used to minimize turbidity in the immediate area caused by the dredging operation.

This type of dredge has the capability of pumping dredged material long distances to a disposal site. If it is assumed that the dredging is to be done at depths of 30 feet or less, the channel material consists of fine sands and silt, and a 24-inch cutterhead suction dredge would be utilized, the maximum length of discharge pipeline would be approximately 10,300 feet. It is anticipated that the length of the discharge pipeline would not be longer than 7,000 feet to the disposal site for this task.

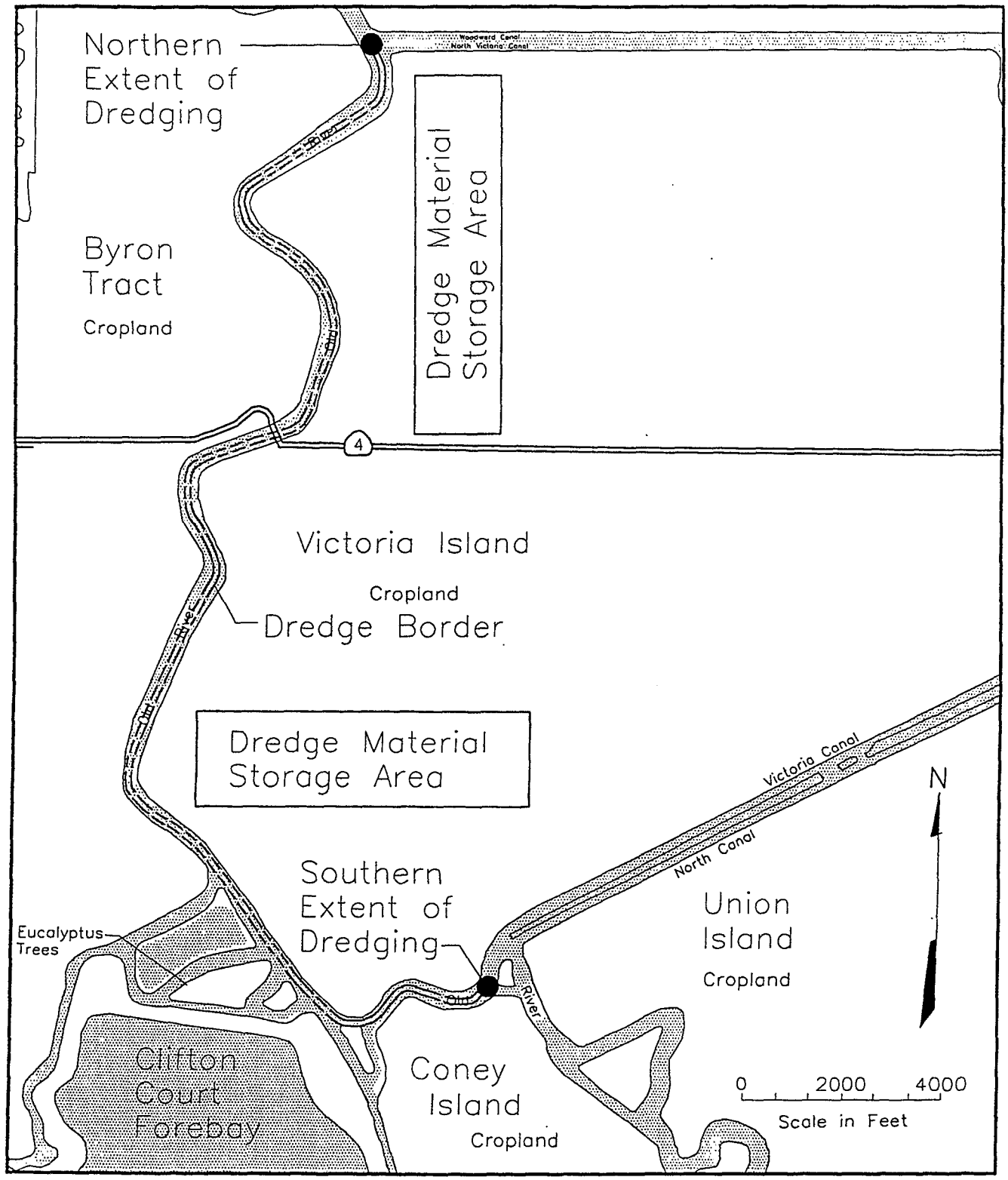

Figure II-4. Channel Dredging, Old River

Two settling ponds would be sited on Victoria Island (see Figure II-4). One pond would be located north of Highway 4 and the other south of Highway 4. Each pond would be approximately 300 acres in size, for a total coverage of approximately 600 acres. The northern pond would be approximately 7,500 feet long and 1,750 feet wide. This pond would contain six separate settling basins each separated by a levee and drained by corrugated metal pipes to facilitate the settling of dredge materials. Once the dredged solids have been decanted, the remaining water would be drained into the existing agricultural drainage ditch on Victoria Island and then pumped back into Old River.

The southern pond would be approximately 6,800 feet long and 2,000 feet wide. This pond would also contain six separate settling basins and would be operated in the same way as the northern pond. Each of the proposed settling ponds would be contained by dikes 4 feet high. Containment dikes would be constructed of native materials. Drainage between basins would be accomplished using corrugated metal pipes.

The material contained in the settling ponds is expected to take several months to drain. Once the dredged material is dried, it would be placed on the land-side of the existing levees surrounding Victoria Island or Byron Tract, or used for other beneficial reuse projects. Placing sediment on the land-side of levees would be accomplished by creating a berm which would reinforce the integrity of the structure and minimize the chance of its failure. The task would be completed under supervision of a licensed geotechnical engineer and measures would be taken to control potential settlement. The necessary soil testing would be conducted to analyze the integrity of the existing foundation. Dredged material would be placed gradually over a period of time to control and monitor potential subsidence.

The dredging operation period would last approximately 24 months with a construction crew of about 10 persons. The estimated cost of the dredge operation is $3 million, not including the indirect costs of lost agricultural production on the 600-acre disposal site. There would also be additional costs associated with moving the drained material from the settling ponds once the drainage of that material is complete. These costs have not yet been estimated.

Component 3: Construct and Operate a Barrier Seasonally in both the Spring and Fall to Improve Fishery Conditions for Salmon Migrating along the San Joaquin River

The proposed Old River Fish Control Structure would be 415 feet in length and 35 feet in width, and would be located at the confluence of the head of Old River and the San Joaquin River (see Figures II-2 and II-5). The structure would be constructed of concrete and would have eight vertical lift gates, each measuring 45 feet long by 10 feet high. A permanent storage area would be constructed for the vertical lift gates, equipment, and for operator parking. This storage area would be bounded by an access gate and fence 60 feet wide by 200 feet long. The vertical lift gates would be raised or lowered by a traveling gantry crane which would be permanently mounted to the barrier. A stationary jib crane, also permanently mounted to the structure, would be used to transfer boats from one side to the other via a sling apparatus once the gates were in place. Docking facilities and stairways to accommodate the transfer of boat passengers from one side to the other would be provided. Miscellaneous features associated with the structure would include floating and pile supported warning signs, water level recorders, and navigation lights.

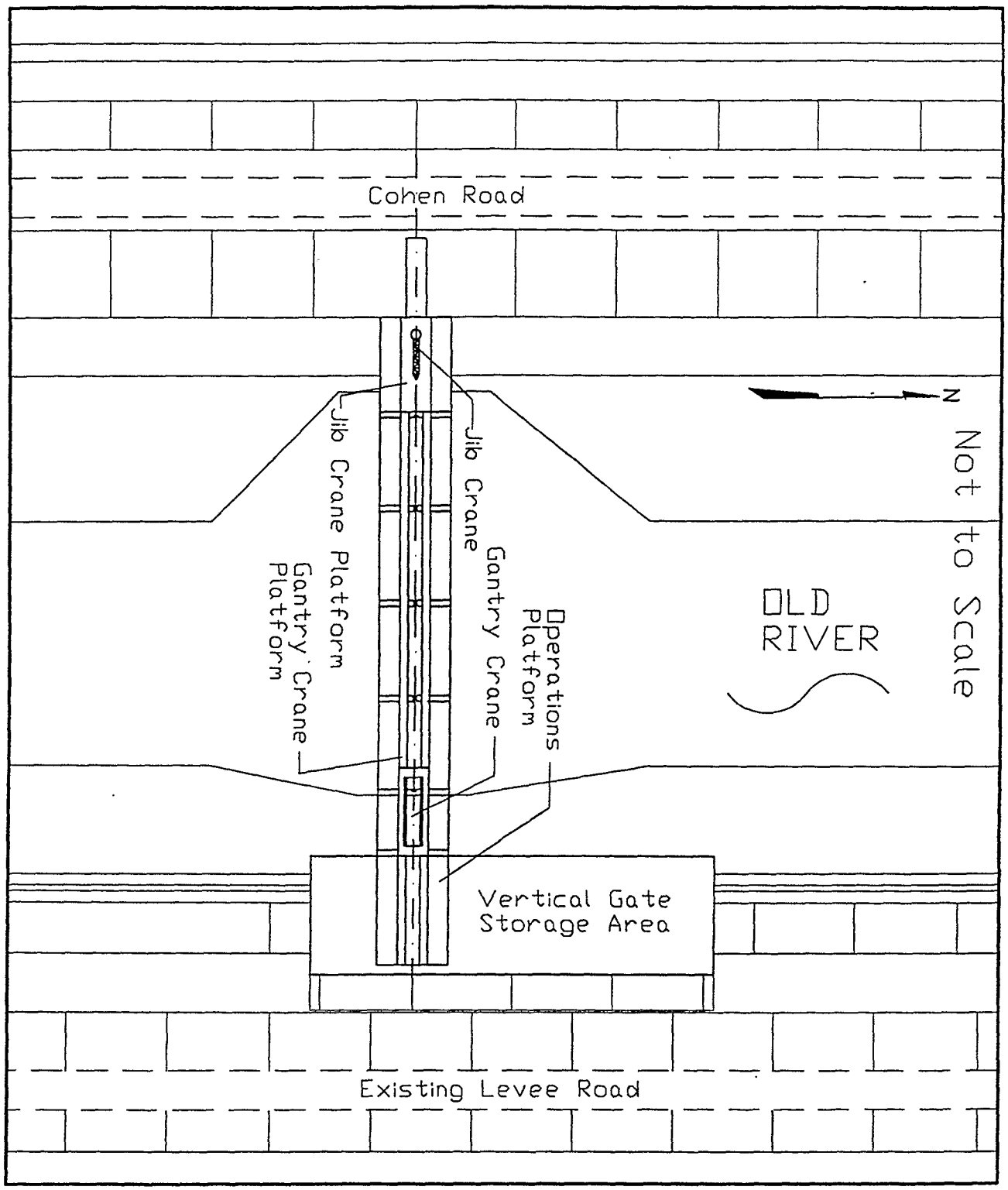

Figure II-5. Old River Fish Control Structure

The fish control structure would be operated from October through November and from April 16 through May of each year except during periods of high San Joaquin River flows. During these periods no flow would occur across the barrier. The operations during the fall would be aimed toward improving the dissolved oxygen levels along the portion of the San Joaquin River from its confluence with the head of Old River downstream to the Port of Stockton. The operations during the spring would be aimed at enhancing the survival of emigrating San Joaquin River salmon smolts by lessening the chances of exposure to the influences of project and local diversions which occur in the south Delta during this time. The exact timing of both the fall and spring operations could be modified on an annual basis, in coordination with the Department of Fish and Game. Consultation with the National Marine Fisheries Service and the USFWS would also be initiated to avoid impacts to winter-run chinook salmon and Delta smelt. The gates would remain fully raised during the non-operational times of the year.

The project would be built within the confines of the existing channel; therefore, no relocation of existing levees is proposed. Access/haul roads for transporting people and equipment would be by an existing county road and/or the construction of a private access road. Roads would be at least 16 feet wide and composed of gravel. Roads would accommodate large cranes (40 tons) and loaded 10-wheel trucks.

Construction would be accomplished in three phases. Each of the first two phases would use one half of the channel cross-section. The third phase would involve construction of the equipment storage area and remaining fixtures. Phases 1 and 2 of the structure would be constructed with the use of sheet pile braced cofferdams. Approximately 47,000 square feet (sf) of steel sheet pile and structural steel members would be required. Upon completion of each construction phase the sheet pile cofferdam would be removed. Approximately 1,700 cy of channel excavation would be required from a 9,500 sf area to construct the substructure for the lift gate structure. Excavation would be accomplished using equipment such as cranes with clam shell buckets, front-end loaders, and bulldozers. Excavated materials would be disposed of either on-site or loaded into trucks or barges for disposal off-site.

The concrete structure would require approximately 1,200 cy of structural concrete and 117 tons of reinforcing bars. Approximately 5,000 sf of riprap would be used as slope protection on existing levees proximate to the barrier. The construction period is estimated to be 30 months with a maximum construction crew of 80 persons. The estimated cost is approximately $5 million.

Component 4: Construct and Operate Three Flow Control Structures to Improve Existing Water Level and Circulation Patterns for Agricultural Users in the South Delta

Three flow control structural barriers would be constructed and operated as a part of the ISDP (see Figure II-2). The three structures are referred to as: 1) Middle River, 2) Grant Line Canal, and 3) Old River. The combination of flow control structures operating would vary over the course of the irrigation season, April through October, as follows: 1) Middle River - April through October; 2) Grant Line Canal -June through September; and 3) Old River - April through October. The Middle River and Old River structures would be operated to allow water to pass upstream into the controlled reaches during higher tides and prevent water levels within the controlled reaches from dropping as the higher tides recede. The Grant Line structure would be operated to allow water to pass upstream into Grant Line Canal during higher tides in addition to permitting a small amount

of downstream flow to pass across the structure during both low tides. All three structures would allow flows to pass freely during the periods of natural or regulated high flow, when the water levels are maintained without the need for flow control.

This component of the ISDP could be utilized independently from the other project components because it alleviates the alleged impacts of existing SWP and Central Valley Project (CVP) exports on South Delta Water Agency (SDWA) agricultural water supply conditions. However, it is important to note that it also alleviates SDWA concerns for the increased levels of SWP export which are proposed for the ISDP.

The facilities associated with each of the three flow control structures are described below.

Middle River Flow Control Structure

The proposed Middle River flow control structure would be located in Middle River, San Joaquin County, near the confluence of Middle River with Victoria Canal, North Canal, and Trapper Slough, approximately 13 miles southwest of Stockton (see Figure II-2). The Middle River flow control structure includes two 25-foot-wide by 16-foot-high radial gates housed in a reinforced concrete gate bay structure, a boat ramp, steel sheet pile wall, and a permanent storage facility (Figure II-6). Structure footprint dimensions are roughly 250 feet long by 55 feet wide. A permanent storage area is also included which would be located on the landward side of the north levee. The storage area would be used to store equipment and provide vehicle parking. This storage area would be bounded by an access gate and 6-foot-high chain link fence 100 feet long by 60 feet wide. The transfer of boats and people would be accomplished with the use of boat ramps.

Since the Middle River channel is shallow, about 7.0 feet deep at this location, construction of this structure would be accomplished by placing a braced cofferdam and constructing the structure within the cofferdam by conventional construction techniques. Construction would be undertaken in three phases. Phase 1 would include the construction of one-half of the radial gate structure using a cofferdam. Phase 2 would include the construction of the other half of the structure. Upon completion of each construction phase, the cofferdam sheet piling would be cut at the required invert depth. Approximately 19,000 sf of sheet piling would be used in the cofferdam.

Phase 3 would involve the construction of the steel sheet pile wall, storage facility, and related work. Approximately 15,000 sf of sheet piling would be required for the construction of the steel sheet pile wall. Approximately 7,700 cy of embankment material would be required for the construction of the storage facility. Newly placed fill material would cover approximately 7,800 sf. Embankment material would be imported and brought on-site using improved access roads. Access/haul roads would be at least 12 feet wide and composed of gravel. Roads would accommodate large cranes (40 tons) and loaded 10-wheel trucks.

The construction period for the Middle River flow control structure would last approximately 18 months with a construction crew of a maximum of 50 persons. Estimated cost is $3.6 million.

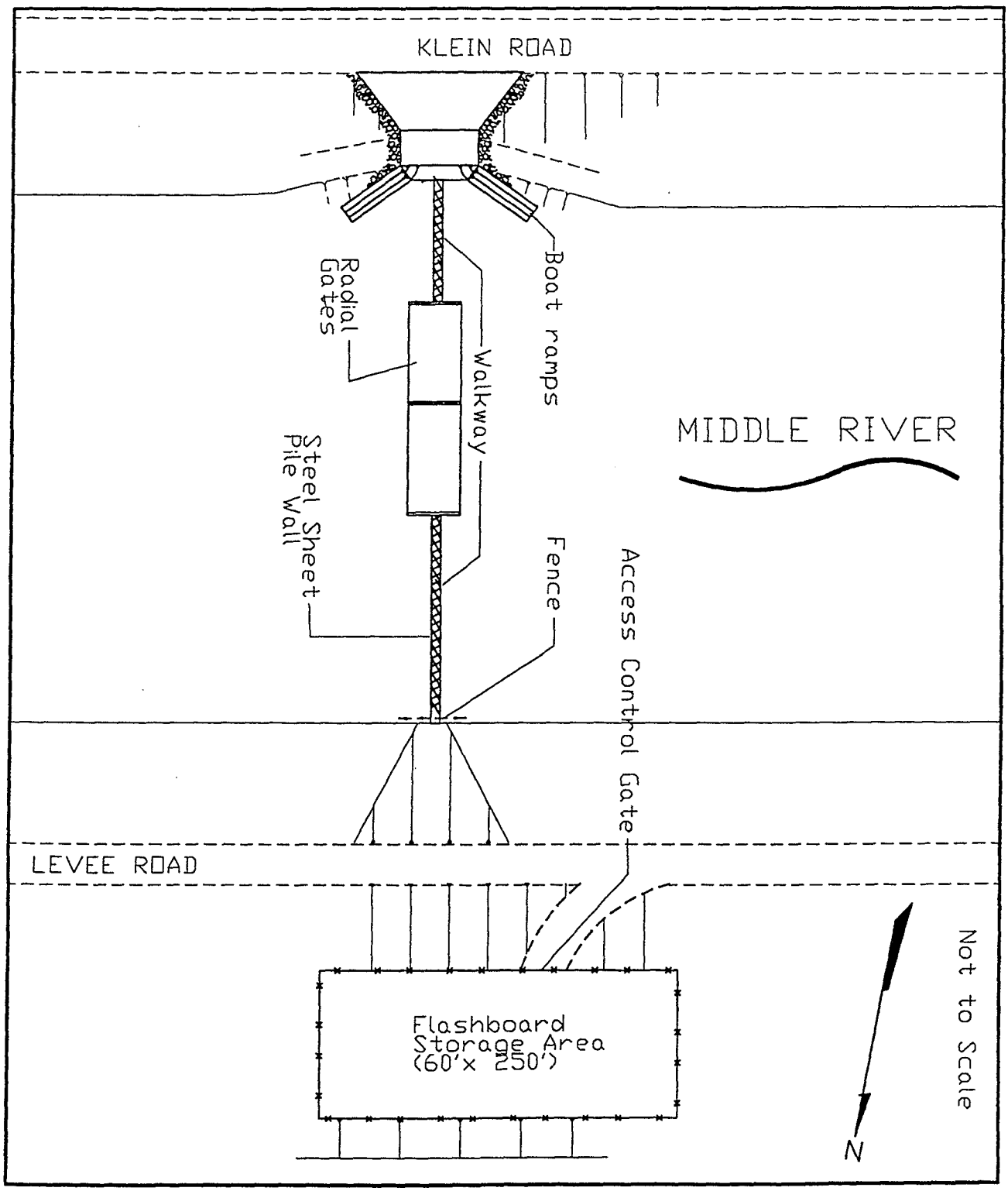

Figure II-6. Middle River Flow Control Structure

Grant Line Canal Flow Control Structure

The Grant Line Canal Flow Control Structure would be located at the confluence of Grant Line Canal and Old River (see Figure II-2). The design includes a concrete control structure that would house four 20-foot-wide by 16-foot-high radial gates, buried utility lines supplying electricity and communications to the area, an access/haul road, equipment storage area, a 50-foot-wide by 105-foot-long boat lock, and a 50-foot-wide flashboard opening for emergency access and regular levee maintenance (Figure II-7). Additional structures would include a control building to house the control systems for the radial gates and a building to house the standby power source (propane). The control building would be constructed on top of the levee adjacent to the boat lock. Other requirements include a microwave tower and an area for flashboard storage. Structure footprint dimensions are roughly 600 feet long by 100 feet wide. This storage area would be bounded by an access gate and fence 100 feet long by 60 feet wide.

The flashboard structure, boat lock, and the control structure would be constructed within the confines of the existing channel; therefore, no relocation of the existing levees would be necessary. Access/haul roads would be at least 16 feet wide and composed of gravel. Roads would accommodate large cranes (40 tons) and loaded 10-wheel trucks.

Construction would be accomplished in four phases. Phase 1 would include the construction of the boat lock using a braced cofferdam. Approximately 2,400 sf of sheet piling would be required for this phase. Approximately 11,000 cy of material would be excavated within the cofferdam limits; 1,300 cy of structural concrete and 134 tons of reinforcing bars would be used to construct the boat lock.

Phase 2 would include the construction of the radial gate structure, also using a braced cofferdam. During this phase, approximately 190,000 sf of sheet piling would be required and 17,000 cy of material would be excavated within the confines of the control structure cofferdam. Structural concrete totaling 1,700 cy and 217 tons of reinforcing bars would be used to construct the control structure.

Phase 3 construction would consist of the construction of the flashboard structure using braced cofferdam procedures. Approximately 1,900 sf of sheet piling would be required for the construction of the cofferdam and 2,500 cy of excavation would be required during this phase. Approximately 1,600 cy of structural concrete and 163 tons of reinforcing bars would be used to construct the structure. Upon completion of each independent construction phase the cofferdam sheet piling would be cut at the required invert depth.

Phase 4 would include the construction of the permanent storage facility and additional facilities. Approximately 22,000 sf of the slope of the existing levee closest to the barrier would be protected with a riprap protective layer. The construction period would last approximately 36 months with a maximum work crew of 90 persons. The estimated cost is $14 million.

Old River Flow Control Structure

The flow control structure on Old River would be located east of the Delta Mendota Canal approximately 4,000 feet southeast of the intersection of the Alameda, Contra Costa, and San Joaquin County lines (see Figure II-2). The structure would be constructed of concrete and would

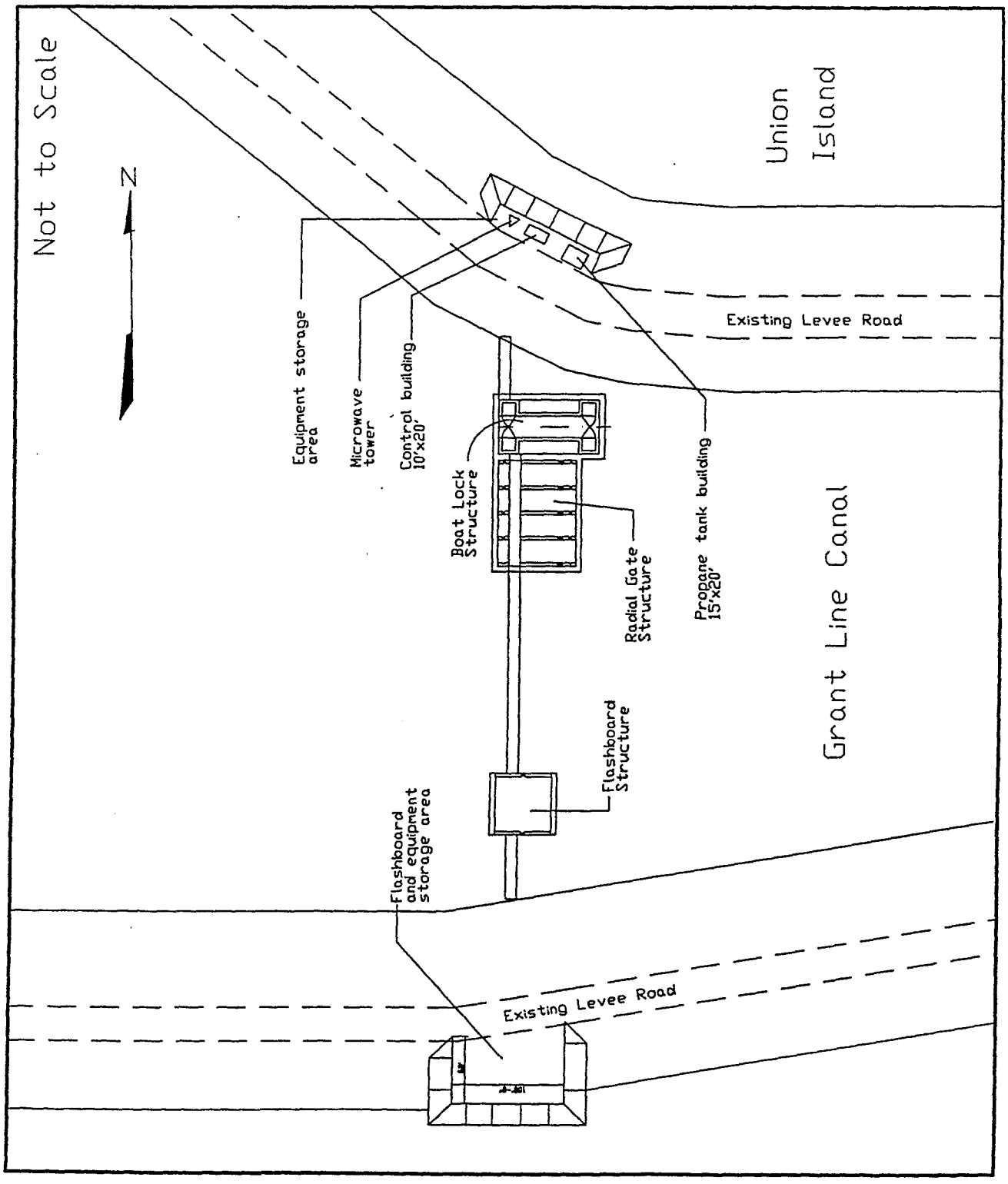

Figure II-7. Grant Line Flow Control Structure

be equipped with three 20-foot-wide by 15-foot-high radial gates, a steel sheet pile wall, channel dredging, buried utility lines supplying electricity and communications to the area, an access/haul road, equipment storage areas, a 50-foot-wide by 105-foot-long boat lock, 1,000 feet of new levee, and a 50-foot-wide flashboard opening for emergency access and regular maintenance (Figure II-8).

Additional structures include a control building to house the control systems for the radial gates and a building to house the standby power source (propane). The control building would be located on top of the setback levee adjacent to the boat lock. Other components include a microwave tower and an area for flashboard storage. Structure footprint dimensions are roughly 400 feet long by 100 feet wide.

The control structure and boat lock would be constructed "in the dry" in an area just north of the existing Old River levee. The new levee, approximately 1,000 feet in length consisting of approximately 32,000 cy of compacted embankment, would be constructed north of the existing levee. The existing north levee would be breached after the structure was constructed. Portions of the existing levee would remain as a channel island.

The new levee section would be built to an elevation of +15.0 NGVD with side slopes of 2 horizontal to 1 vertical. The water-side slope of the new levee section would be protected using approximately 5,600 sf of 18-inch riprap. Approximately 135,000 sf of farm land would be covered with newly placed fill material and lost to agricultural production. Levee roads would be at least 16 feet wide and composed of gravel. Roads would accommodate large cranes (40 tons) and loaded 10-wheel trucks. Imported borrow material would be required to construct access and haul roads.

Approximately 1,900 cy of material would be excavated for the control structure and boat lock and replaced with either imported borrow or tremie concrete. Parts of the structures would be constructed in the excavated area. A sheet pile wall of approximately 16,000 sf would be driven adjacent to the existing levee for its stabilization during construction and to minimize the width of the levee setback. Any spoil material would be removed from the site or used as a stabilizing berm. It is assumed that the new levee setback would be constructed of imported borrow. An anchored sheet pile wall between the boat lock and the new levee would then be constructed and backfilled to allow access to the structures from the new levee. At this point, the existing south levee could be excavated to an invert elevation of -10.0 NGVD.

The flashboard structure would be constructed within a braced cofferdam and consist of a tremie concrete base of approximately 370 cy, structural concrete of approximately 250 cy, and 34 tons of reinforcing steel. An anchored slot would hold the steel flashboards in place. An anchored sheet pile would form the walls of the flashboard structure and serve to absorb impacts of barges, as well as guide boats through the passage. Approximately 17,000 sf of sheet piling would be used for this purpose.

Two permanent storage areas for equipment, flashboards, and operator parking would be constructed. One storage area would be constructed on the south side of the existing levee and would consist of a 100-foot-long by 60-foot-wide area enclosed by a fence and access control gate. The northern storage area would consist of a 25-foot-wide by 120-foot-long area also enclosed by an access control gate and fence.

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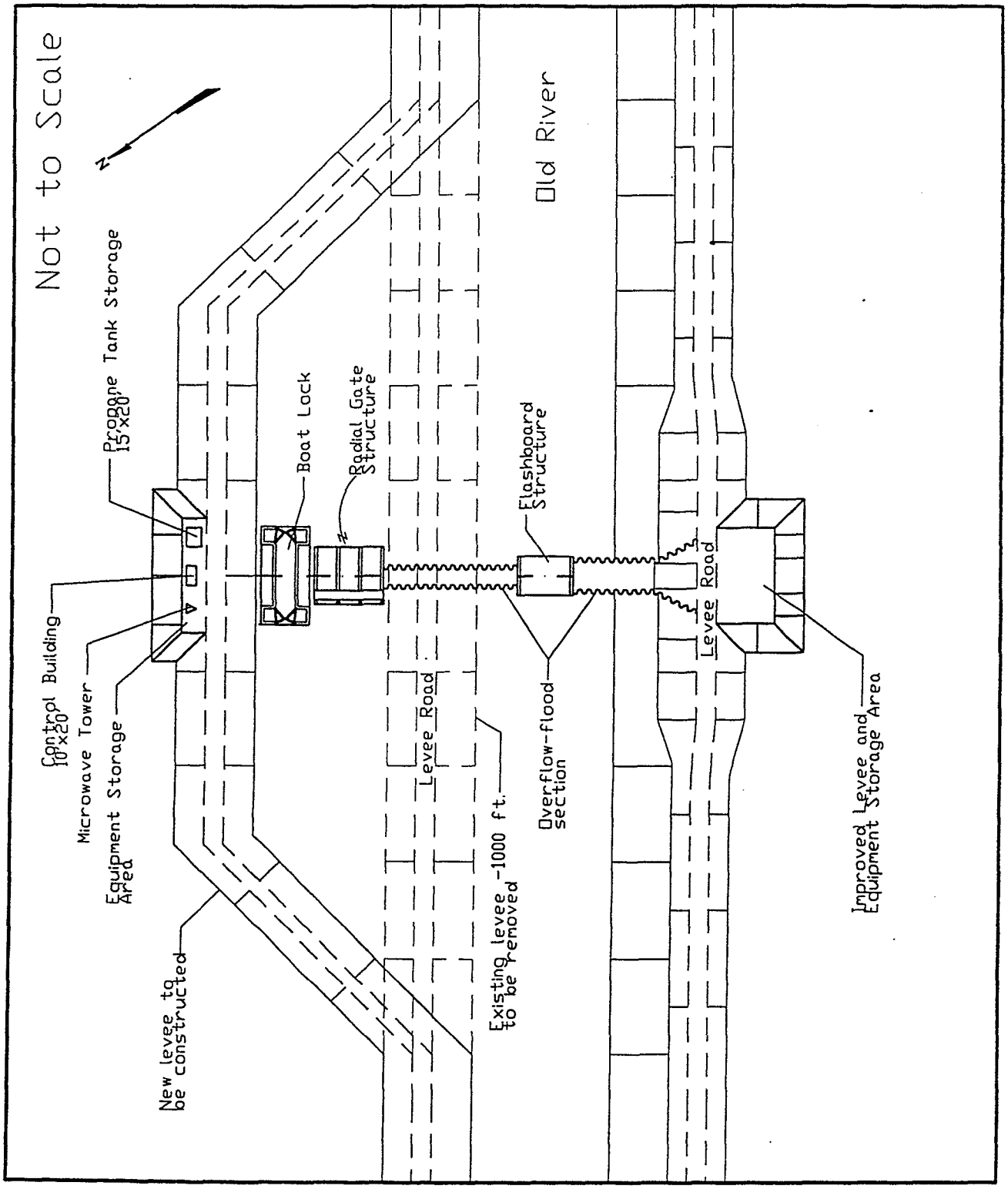

Figure II-8. Old River Flow Control Structure

Temporary haul roads would be constructed of an aggregate base and oil chip-seal design. A permanent access road consisting of an aggregate based chip seal design would be connected to the southern existing county road.

The construction period would last approximately 30 months with a maximum construction crew of 100 people. Estimated cost is $7.5 million.

Component 5: Increase Diversions into Clifton Court Forebay

The proposed ISDP would increase water diversions into the Clifton Court Forebay, a shallow 31,260 acre-foot storage reservoir at the head of the California Aqueduct. The forebay not only provides storage, but also creates the operational flexibility necessary to alleviate the impacts of SWP exports on the surrounding Delta channels. The forebay allows the Banks Pumping Plant to be operated continuously while the actual Delta water diversion can be accomplished during times of higher tides. This avoids diversions from the Delta during times of lower tides, when diversions would have a more pronounced effect on existing water levels in adjacent channels. The water would be diverted into the forebay using the one existing and one proposed intake structures.

This increase in water diversions would require that the U.S. Army Corps of Engineers revise the present conditions contained in Public Notice 5820-A and issue a permit under Section 10 of the Rivers and Harbors Act allowing for such diversions. All diversions would continue to be subject to compliance with other existing constraints governing the operation of the SWP, such as State Board water rights decisions and applicable federal and state laws, including the Endangered Species Act and the Clean Water Act.

The proposed diversions into Clifton Court Forebay would not exceed, on a monthly averaged basis, 20,430 acre-feet per day for any given month. This increased rate of diversion would allow an alteration of the existing pumping patterns at Banks Pumping Plant. It would allow, at times, the utilization of the full pumping capability of the Banks Pumping Plant. Over the course of most years, more water would be pumped from the Delta with the ISDP. The increased SWP pumping capacity, however, would allow the seasonal timing of pumping to be shifted to those times of year when the volume of fresh water flowing out of the Delta exceeds of the volume required by regulatory standards. More water would be pumped when Delta inflows are high, during the late fall and winter precipitation and runoff events, and less water would be pumped during the drier months, when upstream reservoir releases are required to meet Delta regulatory standards.

The use of the additional pumping capacity would vary depending upon the water year. The full pumping capacity would generally be limited to rare storm events during the dry and critically dry years. There would be opportunities to use the maximum pumping capacity during wet, above normal, and below normal years. In above normal and below normal years, the additional water that would be pumped and exported could be a significant percentage of freshwater inflows.

The following two sections provide a more detailed description of the hydrodynamic changes that would occur in the Delta with the implementation of the ISDP. First described is how DWR and USBR coordinate their operations to ensure that all regulatory standards in the Delta are met. Next, changes to Delta hydrodynamics are described, organized according to changes in Delta inflows, Delta exports and outflow, and within-Delta flow. Appendix 4 of the ISDP Draft EIR/EIS

(Entrix 1995) contains a comprehensive discussion of project-related changes to Delta hydrodynamics, and the numerical techniques and results used to predict these changes.

Operational Coordination of SWP and ISDP

DWR and USBR would continue to jointly coordinate the operations of the SWP, with the ISDP and CVP to assure that the various Delta regulatory requirements continue to be met following the implementation of the ISDP. This coordination would continue to be accomplished, first, by jointly planning the operations to achieve the target levels. Then, the project operation and Delta conditions would continue to be jointly monitored to ensure that the planned operations are adequate, and project operations are adjusted as necessary. The procedures, to be continued with the ISDP, are described below.

To plan weekly project operations, Bay/Delta tides are estimated using National Oceanic and Atmospheric Administration's forecasted tides and regression relationships with flow and salinity at various Delta locations. Based on the best estimates of weather conditions and past experience, a target Delta outflow is determined which is expected to meet the controlling water quality standard, as well as other standards. DWR attempts to provide a reasonable buffer level of protection for complying with all pertinent Delta water quality standards. DWR and USBR coordinate reservoir releases to meet the target outflow.

During actual daily project operation, data is transmitted on an hourly basis to DWR and USBR hydrometeorological systems. These data consist of river flows, tides, salinity, and wind speed/direction at various Delta locations. If the data indicate a significant deviation from the planned conditions, then one or more of the three following operational changes can be implemented: adjust project reservoir releases, adjust Delta export levels, and close or open the Delta cross-channel gates. Reservoir releases are most effective for meeting Sacramento River salinity criteria (most frequently at Emmaton) or Delta outflow criteria. San Joaquin River salinity criteria (most frequently at Jersey Point) are most effectively met by adjusting the amount of export pumping.

Regardless of the operating strategy, SWP and CVP operations only significantly influence salinity at locations where project operations significantly influence tidal circulation, such as in the main channels of the Sacramento River and San Joaquin River. At other locations, such as the Contra Costa Canal intake at Rock Slough, tidal circulation is generally poor and the salinity can be strongly influenced by the local discharges of land-derived salts. Changes in project operations will only marginally influence the water quality at Delta locations with these physical limitations.

Project-Related Hydrodynamics

Delta Inflow

Runoff from Central Valley rivers and streams accounts for approximately 95 percent of the inflow to the Delta. Approximately 70 percent of the inflow comes from the Sacramento River basin, 15 percent comes from the San Joaquin River basin, and 5 percent comes from the Central Sierra Basin

through the Eastside Streams (State Board 1991b). Delta inflow elements that are changed as a direct result of the ISDP are total storage in Lake Oroville and the flows in the Feather and Sacramento rivers. These elements are closely related to the operation of the dam at Lake Oroville and are discussed in the following section. The other elements of the water supply system are operated by the CVP and other water agencies, and will not be directly affected by the project.

The critical years illustrate the most extreme changes to Delta inflows resulting from the operational flexibility provided by ISDP's increased export pumping. Minimum and maximum pool levels of Lake Oroville would be unchanged through this alternative, however, the timing of fluctuations would change slightly. Exports from Banks Pumping Plant are increased from October through January in the critical year average. To help support the increase in exports, releases from Lake Oroville are increased, flows on the Feather and Sacramento rivers are increased, and total Delta inflow is increased by up to 5 percent. From February through April, there is little or no change with the ISDP; reservoir levels in Lake Oroville are slightly lower with ISDP owing to the increased releases in late fall and early winter. From May through September, exports from Banks Pumping Plant are decreased with ISDP. Releases from Lake Oroville are reduced during this period, and as a result flows on the Feather and Sacramento rivers are decreased, and total Delta inflow is decreased down to 8 percent. These changes are illustrated in Figure II-9.

Appendix 4 of the ISDP Draft EIR/EIS (Entrix 1995) contains a detailed analysis of ISDP-related changes to inflow for both existing and future demand during all year types. The general patterns illustrated by the critical year averages are similar for the other year types. Although some elements differ from the general case, the critical year patterns exhibit the most extreme changes on a percentage basis.

Delta Exports and Outflows

Changes in the export rate from Banks Pumping Plant represents the direct influence of the proposed project. The ISDP would improve SWP reliability, but would affect Delta outflow and downstream reservoir storage. The following ISDP-related changes are discussed in this section: 1) Banks Pumping Plant exports, 2) SWP delivery reliability, 3) downstream reservoir storage, and 4) Delta outflow.

The changes in timing of Delta exports under the ISDP reflects the operational flexibility provided by the increased pumping capacity at Banks Pumping Plant. More water is pumped and exported with the project than without it, but the seasonal timing of pumping is generally shifted so that more water is pumped during the late fall and winter, while less water is pumped during the drier months. Pumping is increased by more than 10 percent (compared to no project) in October, November, and December of most year types. October is typically the month with the greatest increase in pumping: 17 to 38 percent depending on the year type. Pumping is decreased by more than 10 percent (compared to no project) during May, June, and July of critical and dry years, and during February and March of above normal and wet years. The delivery capability of the SWP with and without the ISDP is summarized in Table II-1. The future demand case calls for approximately 4,116,000 acre-feet of SWP water each year, and the ISDP would result in a 6 percent decrease in shortage frequency.

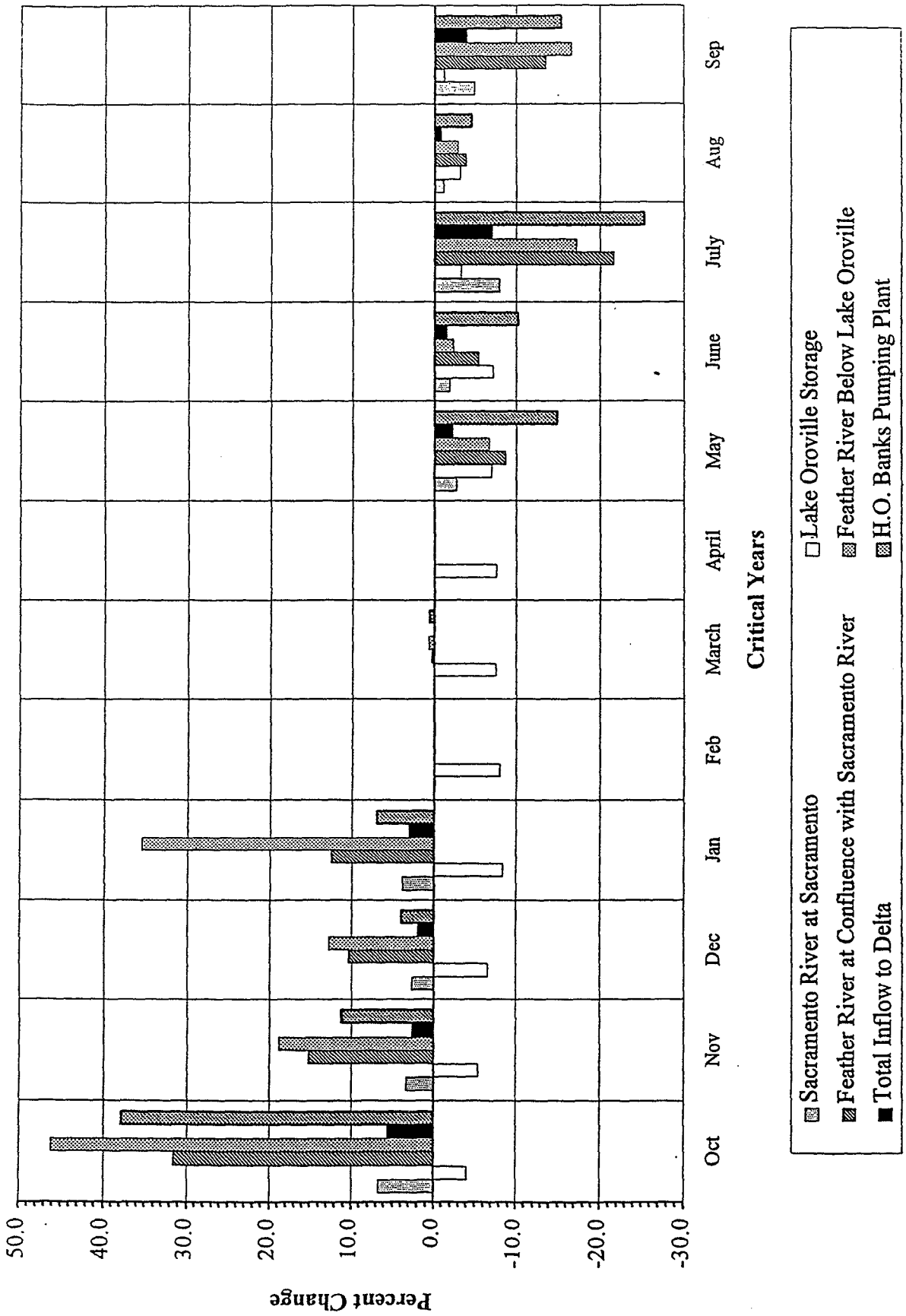

Figure II-9. Delta Inflows, Percent Change Based on Average Monthly Flow Existing Demand Case

Table II-1. Summary of SWP Delivery Capability Analysis

PARAMETER	Existing Demand Case Study		Future Demand Case Study	
	w/o ISDP	w/ ISDP	w/o ISDP	w/ ISDP
1. Entitlement Request (excluding losses), TAF/Year	3510	3510	4116	4116
2. Frequency of Shortages in SWP Deliveries	90%	87%	89%	83%
3. Average Annual Dry Period Supply, TAF/Year	2146	2188	2131	2174
4. 71-Year Average Annual Delivery, TAF/Year	2724	2724	3030	3103
5. Volumetric Reliability	13%	16%	15%	22%
6. Lowest 1-year Delivery, TAF (in 1977)	436	436	436	436

Footnotes:
1. Feather River Service Area requests and California Aqueduct losses are not included.
2. Number of years entitlement requests are not met divided by 71 delivery years.
3. Total deliveries from March 1928 through February 1935, divided by 7 delivery years on the long term (71) year study.
5. Total volume (71 years) of delivery, divided by total volume (71 years) of entitlement requests.

TAF = Thousand acre feet
Source: DWR (1990)

C—0 5 2 3 7 5

The reservoirs receiving SWP export water are: San Luis Reservoir (SWP portion), Castaic Lake, Pyramid Lake, Silverwood Lake, and Lake Perris. The operation of the SWP portion of San Luis Reservoir changes to accommodate the change in timing of exports from the Delta. When pumping from the Delta is high, the volume of water stored in San Luis Reservoir increases, sometimes over 100 percent of the no-project storage level. The southern California reservoirs are operated for water storage and generation of hydroelectric power. The SWP reservoirs in southern California are generally unchanged by project operation. There would likely be minor changes in these reservoirs resulting from the ISDP, since operations are already near normal cycle minimum levels.

Although Delta outflow past Chipps Island would likely decrease as a result of the ISDP, the largest reductions are up to 11.7 percent of the no-project outflow. The greatest decrease in outflow would occur during September of wet years. During that time, total dissolved solids concentration within Suisun Bay and at Benicia would increase by approximately 1000 ppm at any given location.

Within-Delta Flows

Project-related changes to flows within the Delta depend on the water year type, tidal conditions, and on the hydrology of the Delta during the change in exports. The flow patterns in the south Delta in particular are strongly dependent on the operation of the barriers and modification of the intake channels adjacent to Clifton Court Forebay. These changes are discussed in the following subsections.

Delta-Wide Circulation

Circulation patterns in the north Delta would generally be unchanged by the ISDP. The magnitude of flows, however, would be affected by changes in flows of the Sacramento River. These changes are discussed as part of Delta inflow. The ISDP would result in slight changes in the percentage of Sacramento River flows through the Delta Cross Channel and Georgiana Slough.

Circulation in the central Delta would change with the ISDP under some conditions. Flow reversals would generally occur during October through December of most year types, and decreases in flow reversals would occur during February through July of above normal and wet years. These changes correspond to changes in exports from Banks Pumping Plant and Delta inflows. Central Delta flow and circulation would also be affected by barrier operation, as discussed in the next section.

Salinity intrusion from San Francisco Bay would be slightly changed by the ISDP. As Delta outflow decreases, the position of X_2 moves east. Changes are on the order of tenths of a kilometer, with the greatest changes (up to a kilometer) occurring during September.

Barriers

Flows in the south Delta would be changed as a result of barrier operation. Over the course of a water year, there would be seven different barrier operations, as follows: 1) October - Middle, Old River, Old River near Mossdale; 2) November - Old River near Mossdale; 3) December through March - no barriers; 4) April 1 through April 15 - Middle River, Old River; 5) April 16 through May - Middle River, Old River, Old River near Mossdale; 6) June through September - Middle River, Grant Line Canal, Old River; and 7) San Joaquin River flow at Vernalis greater than 5,000 cfs - no

barriers (Figure II-10). This last condition would occur during wet years in April, May, and June, according to the model results, and hence the model for those months does not include barriers.

Water levels and circulation are improved upstream of the barriers by tidal pumping. Tidal pumping allows upstream flow during the flood tide and blocks downstream flow during the ebb tide. This operation retains flood tide flows in south Delta channels to raise water levels. The Grant Line Canal barrier is open for a portion of the ebb tide to increase circulation by providing a downstream outlet. The increase in water levels routes San Joaquin River flows north towards the central Delta, rather than through the south Delta to the export pumps.

The effects of the barriers on tidal patterns, water levels, and water velocities are discussed below.

Tidal Influence. The barriers would influence the tidal level and the tidal pattern. With the barriers installed, the mean low-low tide upstream of the barriers would be maintained at a higher level than without the barriers. Mean high-high tide would be marginally affected by the barriers. The sinusoidal tidal pattern of water levels would be shifted forward in time with the barriers installed.

Water Levels. The barriers would have a major influence on minimum water levels throughout most of the south Delta, as depicted in one of the extreme cases, June of the representative dry year (Figure II-11). Water levels would be higher upstream of the barriers for more than 15 miles, and water levels downstream of the barriers would be marginally reduced.

During all but the wet year, the average water levels upstream of the barriers would increase at most by approximately 5 percent of the total water depth. In wet years the increase in average water depth would be at most twice that amount. Over the average tidal cycle, the maximum water surface elevation would change very little, since the barriers would be designed to pass upstream flow. With the barriers closed, however, the minimum elevation would be much higher with than without the barriers, and it would be this increase in the minimum water surface elevation that would lead to the increase in the daily average water level. During all year types, the average water levels downstream of the barriers would decrease at most by approximately one percent of the total water depth. This change would not be considered significant.

Average water surface elevations upstream of the fish control structure would increase up to 5 feet, and downstream of the structure the water surface would decrease up to 2 feet. Over a tidal cycle, the maximum water surface elevation downstream in Old River would be nearly unaffected, but the minimum elevation would decrease owing to less inflow from the San Joaquin River.

Water Velocity. The barriers would reduce the maximum (or downstream) velocity to nearly zero upstream of the barrier. The minimum (upstream) velocity is modeled to decrease, primarily as a result of increased diversions at Banks Pumping Plant. Changes in the average velocity would be controlled by the large reductions in maximum (downstream) velocities.

The operation of the barriers is not expected to lead to excessive scour or sedimentation. The modeled peak flow velocities for the post-project conditions do not approach the scour criteria of 3 feet per second. Minor levels of sedimentation might occur during times of tidal pumping due to periods of relative stagnation behind the barriers. The exact amount of sediment settling out of suspension would depend on the total suspended sediment value for the particular channel and details of flow behavior in the channels.

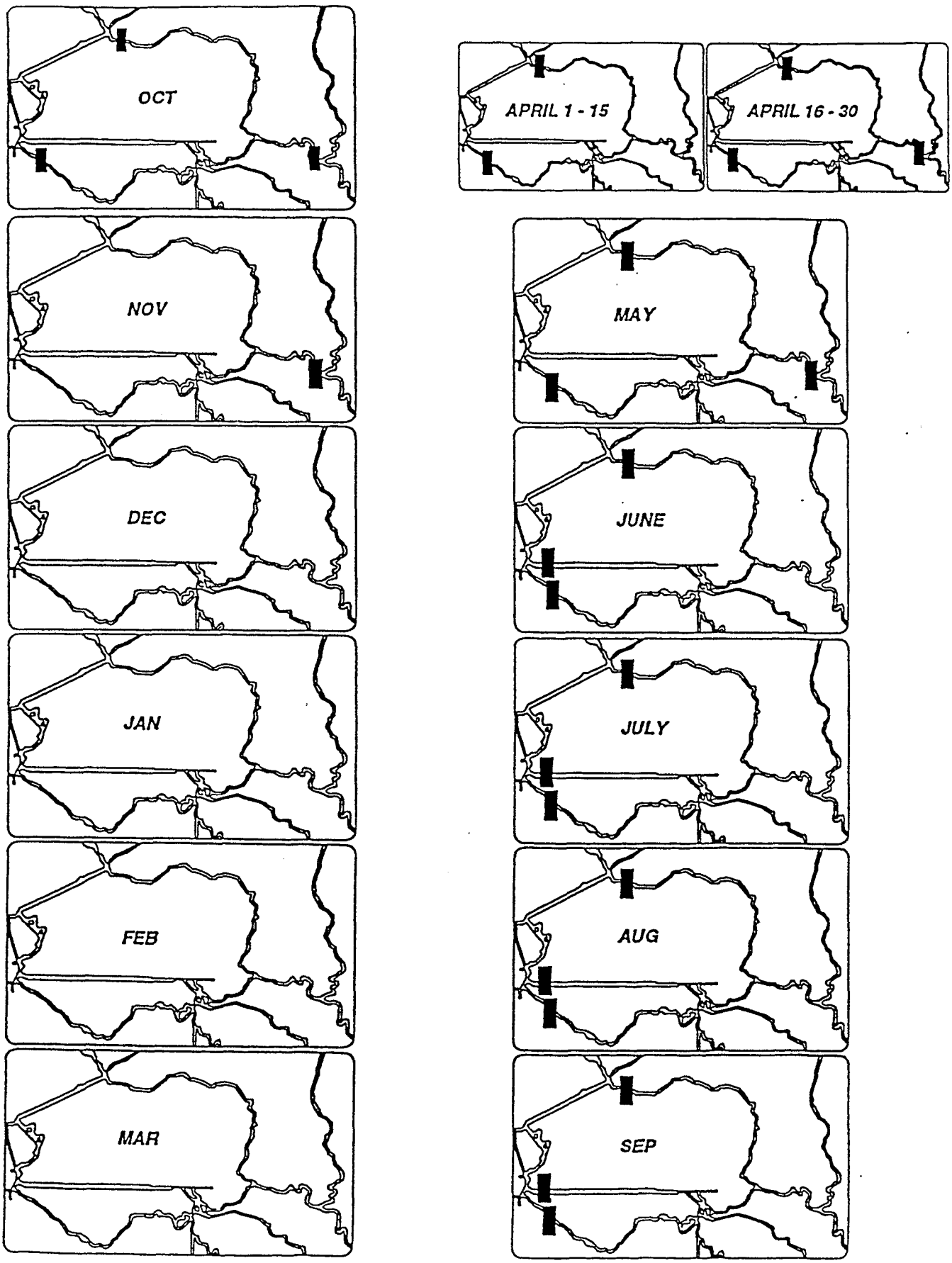

Figure II-10. Proposed Barrier Operation for ISDP

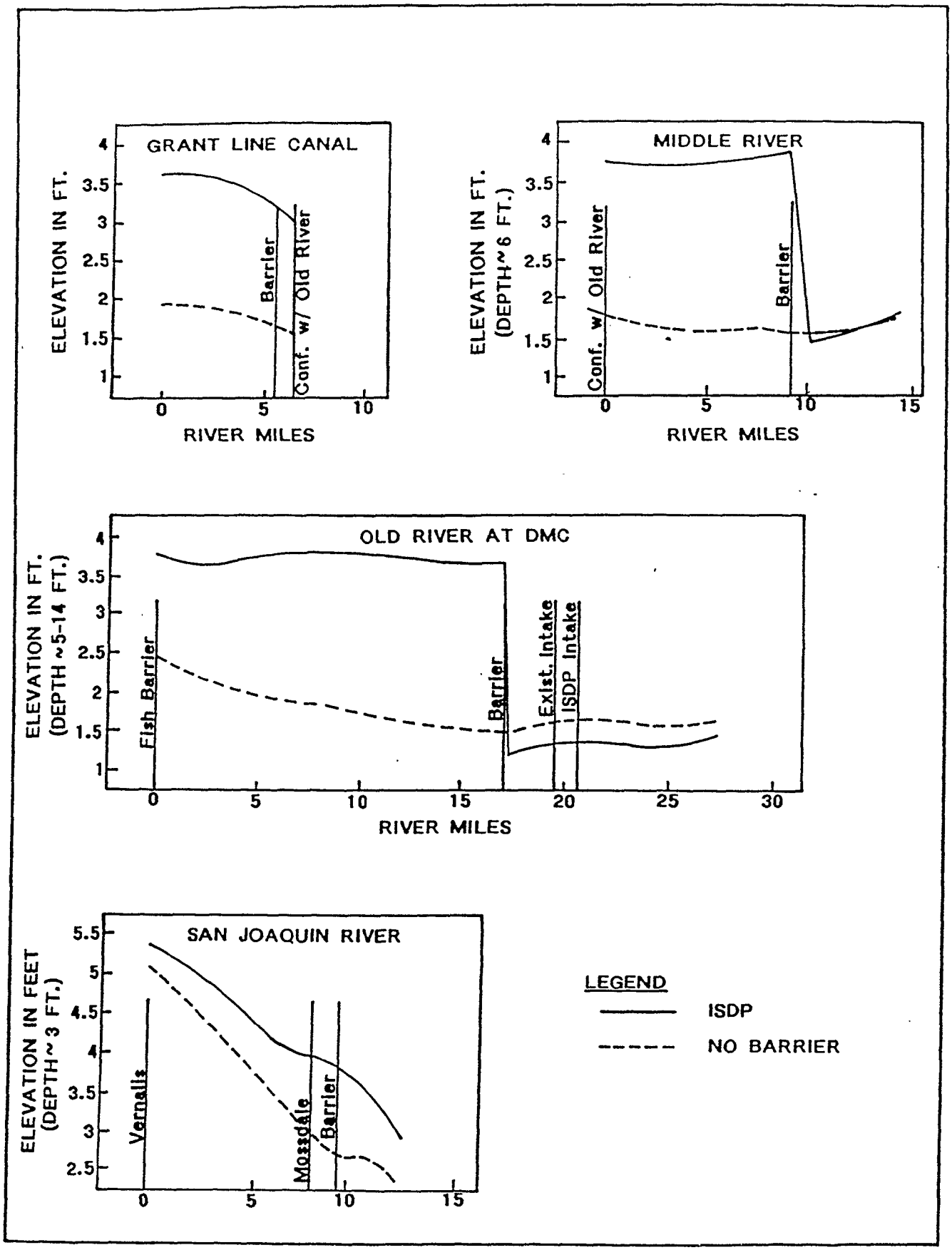

Figure II-11. Change in Minimum Water Levels (June, Dry Years)

III. ALTERNATIVES TO THE PROPOSED PROJECT/ACTION

Introduction

Eight alternatives are evaluated in this Biological Assessment. These are the same alternatives that are evaluated in the ISDP Draft Environmental Impact Report/Environmental Impact Statement (EIR/EIS) prepared by Entrix (1995). The alternatives selected for detailed evaluation were developed in consultation with the Corps, USFWS, EPA, NFMS, and DFG, in compliance with the letter and spirit of both CEQA and NEPA. Each alternative is described in detail, beginning with the original South Delta Water Management Project. It should be noted that the ISDP was designed as a scaled-down version of this project in an attempt to achieve some key project objectives in a more environmentally conservative manner.

1. Enlargement of Clifton Court Forebay, Construction of Two Intake Structures, Increased Export Capability, and Construction of Permanent Barriers

This alternative, the original South Delta Water Management Program preferred alternative, would include five project components. Three of the components are exactly as described for the ISDP: 1) increase export capabilities at Clifton Court Forebay, 2) construct and operate a seasonal barrier, and 3) construct and operate three tidal control facilities. Two of the components are different from the ISDP; these are described below.

Enlarged Clifton Court Forebay

Clifton Court Forebay would be enlarged from 2,100 surface acres to more than 5,000 surface acres. The northern portion of Victoria Island and the remaining area of Clifton Court Tract would be used to enlarge the forebay (Figure III-1). The southeast portion of Byron Tract would be used to hydraulically connect the existing forebay to the new area. The enlarged forebay would require an estimated 150,000 cy of excavation, 6 million cy of embankment, and 600,000 tons of riprap material.

Twelve miles of levee would be required for the dam embankment. It is assumed that the new embankment can be safely built on the existing foundation material, since adjacent existing levees have been constructed on the same foundation with steeper side slopes. It is planned that the material dredged from the channels be placed in the embankment area.

In addition to the dredged material, about 6 million cy of borrow material would be imported for the construction. The estimated quantity of borrow for the embankment has been increased by 15 percent to account for the expected settlement. Embankments would be provided with a toe drain to tie into the existing drainage system on the islands. Wells would also be installed to monitor potential seepage.

The enlargement of the forebay would also require the realignment of Highway 4. This includes construction of a roadway parallel to the existing roadway alignment. The relocation would consist of about 1,500 linear feet of embankment and a 628-foot, multi-span, reinforced concrete bridge near the eastern portion of Byron Tract. The bridge would be a slab bridge with pile supports spaced at

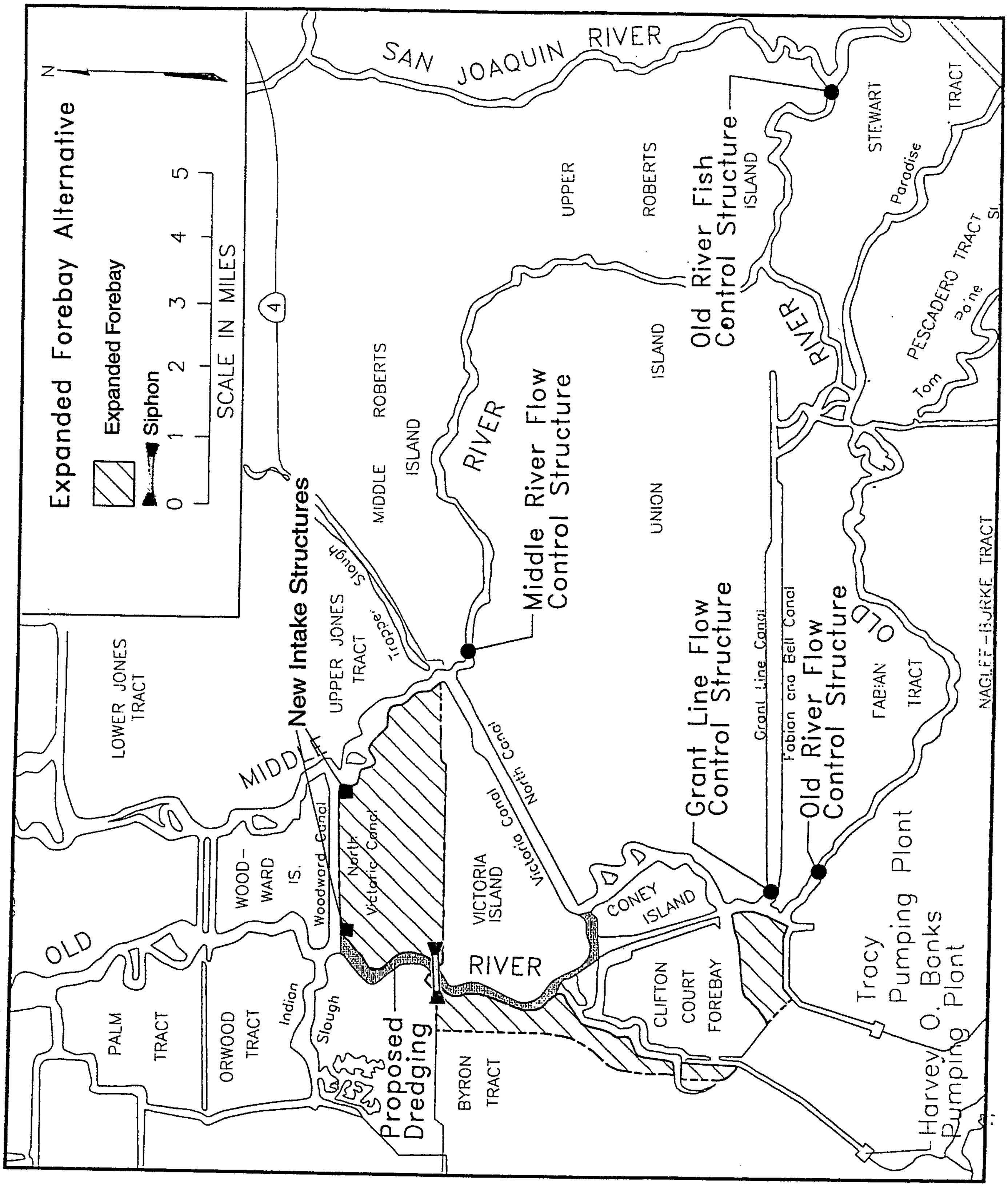

Figure III-1. Enlarged Forebay Alternative

a 26-foot minimum. It is estimated that 80-foot-long, precast, and prestressed concrete piles would be needed for the pile supports. The roadway section would be 14 feet above mean sea level (MSL) and would consist of two 12-foot-wide traffic lanes with 8-foot shoulders for emergency parking. During modifications and restoration, Highway 4 would be detoured. For a period of 24 to 38 months, motorists could expect delays of about 5 minutes.

A siphon structure to be located between Byron Tract and Victoria Island would be used to hydraulically connect the expanded forebay areas (see Figure III-1). Each conduit would be made up of cast-in-place reinforced concrete and would be about 700 feet long, 25 feet wide, and 25 feet high. The siphon structure would be capable of conveying flows of 15,300 cfs at a velocity of about 6 feet per second.

New Intake Structures

Two new intake structures would be constructed on the north end of the expanded forebay. One intake structure would be located at the confluence of North Victoria Canal and Middle River. The second intake structure would be located at the confluence of North Victoria Canal and Old River (see Figure III-1). The new intake structures would have the same configuration as the existing Clifton Court Forebay intake structure. The facilities would have a maximum of five gates, each about 20 feet wide and 30 feet high. The proposed intakes would be sized to divert a peak flow of about 30,000 cfs.

The typical construction method for a concrete control structure with one or more gates is to build the structure on dry land near the site and float the structures into the project area. Construction of the forebay intake would require about 3,000 cy of concrete and 9,000 tons of riprap materials.

The two new intake structures would operate similar to the existing intake structure. The structures would be operated either in conjunction with or independent of the existing intake, depending on the amount of water to be diverted, water quality, specific tidal conditions, or other factors. The gates would be closed when the water level outside the forebay recedes, to retain water in the forebay.

Hydrodynamics

This alternative differs from the ISDP by increasing the size of Clifton Court Forebay, providing two new intake structures at the northern edge of the new forebay and by widening a portion of Middle River to increase its hydraulic capacity, rather than dredging a portion of Old River. This alternative would not change the amount of increased export capability and it assumes that demand is the same as for the ISDP.

Since export capability is not changed in this alternative, it is likely that the pumping schedule modeled by DWRSIM for the ISDP would also not change. If this is the case, then this alternative would not change any of the impacts that were modeled for the ISDP with respect to Delta inflow, Delta outflow, Delta exports, or operation of SWP reservoirs. There would be some minor differences in flow velocities, local circulation patterns, and water level elevations, depending upon whether the barriers were operating.

2. Reduction of CVP/SWP Exports and Management or Reduction of Demand for SWP Water

This alternative was developed through discussions with staff from DFG, USFWS, NMFS, and the U.S. Environmental Protection Agency and consists of two components: 1) management of combined CVP and SWP Delta exports to improve water levels and circulation in the south Delta during the agricultural season, and 2) management/reduction of pumping demand, as described below.

Component 1. Management of CVP/SWP Delta Exports

The irrigation season in the south Delta typically extends from April through September, with peak demands occurring in July. Pumping at the Banks Pumping Plant (SWP) averages 3,800 cfs in April, 5,000 cfs in August, and 3,600 cfs by September. Tracy Pumping Plant (CVP) averages 3,200 cfs in April and 4,000 cfs during July through September. This component of the alternative examines whether a reduction in pumping at the Tracy and Banks pumping plants would significantly improve water levels and circulation in the south Delta.

To assess the effect of reducing CVP and SWP pumping, computer simulation analysis was done which compared a base scenario with a scenario which assumed pumping at the Tracy and Banks pumping plants was restricted during the irrigation season (April through September) to a total of 1,500 cfs -- 1,000 cfs at the Tracy Pumping Plant and 500 cfs at the Banks Pumping Plant. A critically dry condition was also assumed in order to show the maximum amount of improvement pumping restrictions could provide. The changes in water levels and salinities were evaluated at locations throughout the south Delta.

Figure III-2 maps the locations used in the analysis. Figures III-3 and III-4 are plots of the changes in water levels resulting from the pumping reduction. As shown in the plots, water levels increase 0.10 foot in April, 0.25 to 0.35 foot in July, and 0.10 to 0.20 foot in September. Figures III-5 and III-6 are plots of the changes in salinity. For all locations except Old River at Highway 4 (# 90), salinity remains the same or increases when pumping is reduced. The increases vary throughout the irrigation period. A maximum increase of 200 total dissolved solids (TDS) is projected for the San Joaquin River at Lathrop in July. Salinity in Old River at Highway 4 (#90) is worse during April and May with reduced pumping however, it improves up to 200 TDS during June through September.

Component 2. Management/Reduction of Pumping Demand

This component assumes that appropriate water supply management or demand reduction options are implemented in combination with the reduction in Delta pumping (combined SWP/CVP pumping in April through September limited to 1,500 cfs) assumed in Component 1. Bulletin 160-93, the update of the California Water Plan, was released in October, 1994 by DWR. This document identifies a number of supply and demand management options for meeting the State's future needs which fall into two major categories.

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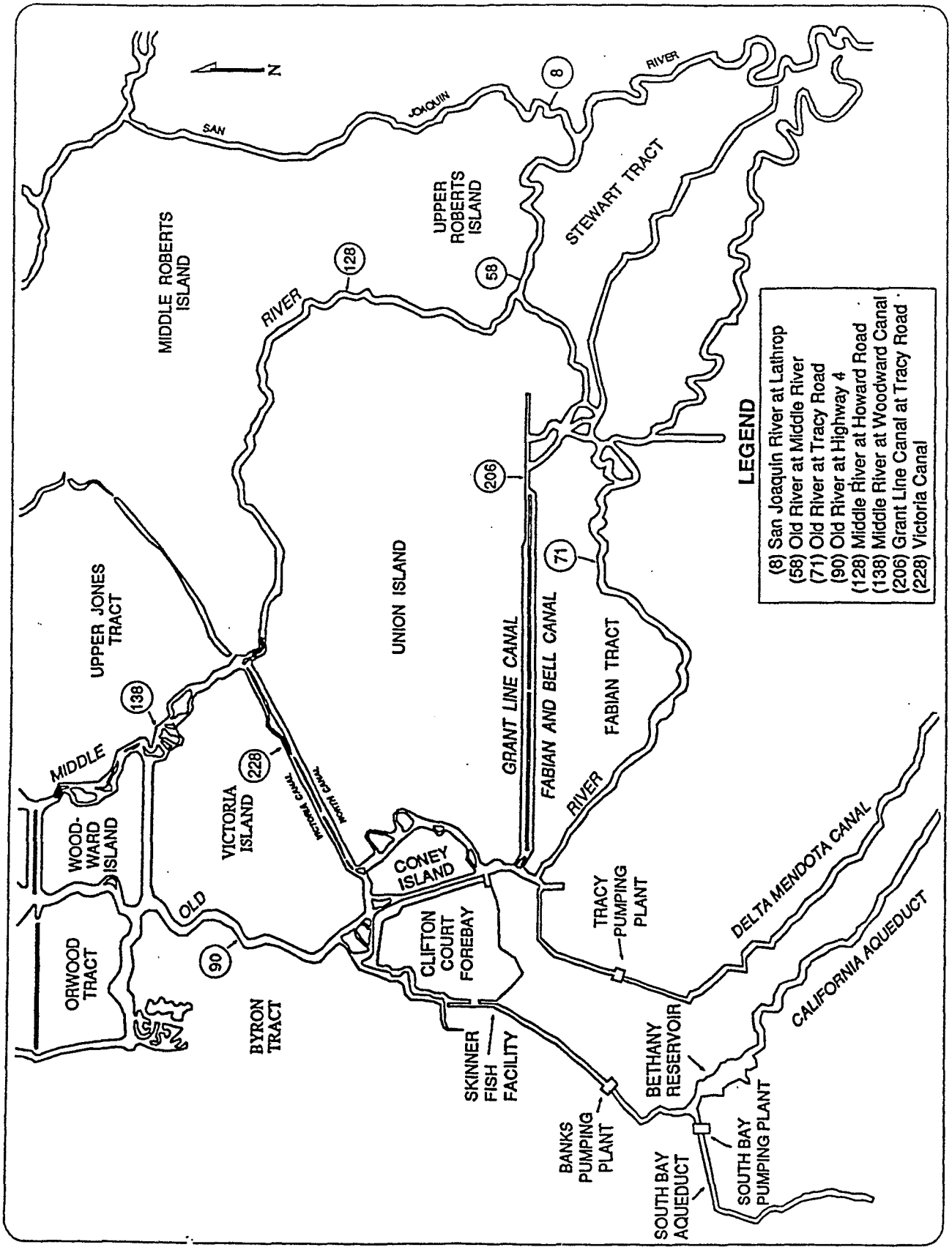
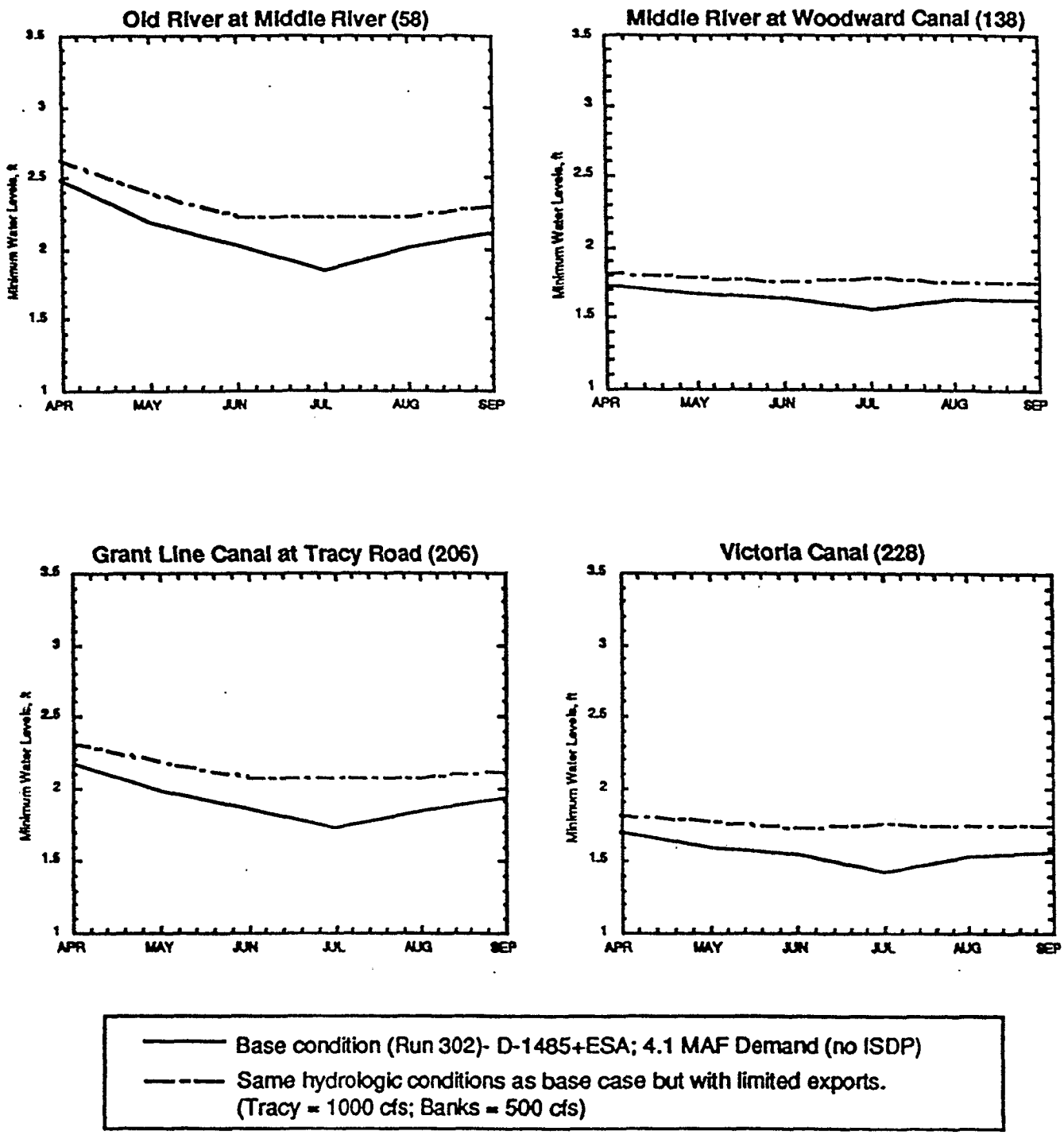
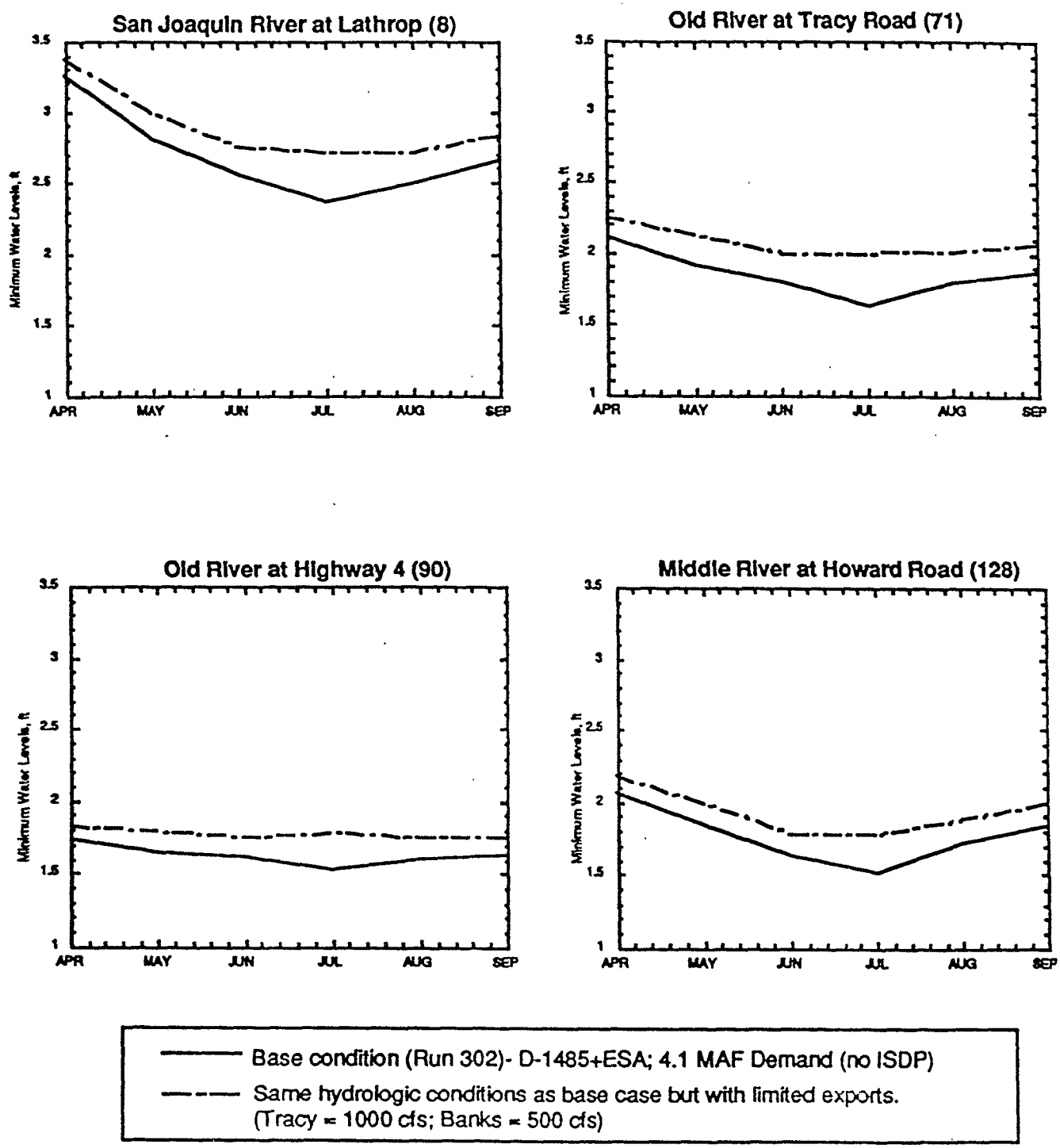


Figure III-2. Computer Analysis Locations



* Minimum Water Level Above Mean Low Low Water (MLLW).

Figure III-3. Minimum Water Level* Comparison of Limited Exports to a Base Condition During a Critical Year



* Minimum Water Level Above Mean Low Low Water (MLLW).

Figure III-4. Minimum Water Level* Comparison of Limited Exports to a Base Condition During a Critical Year

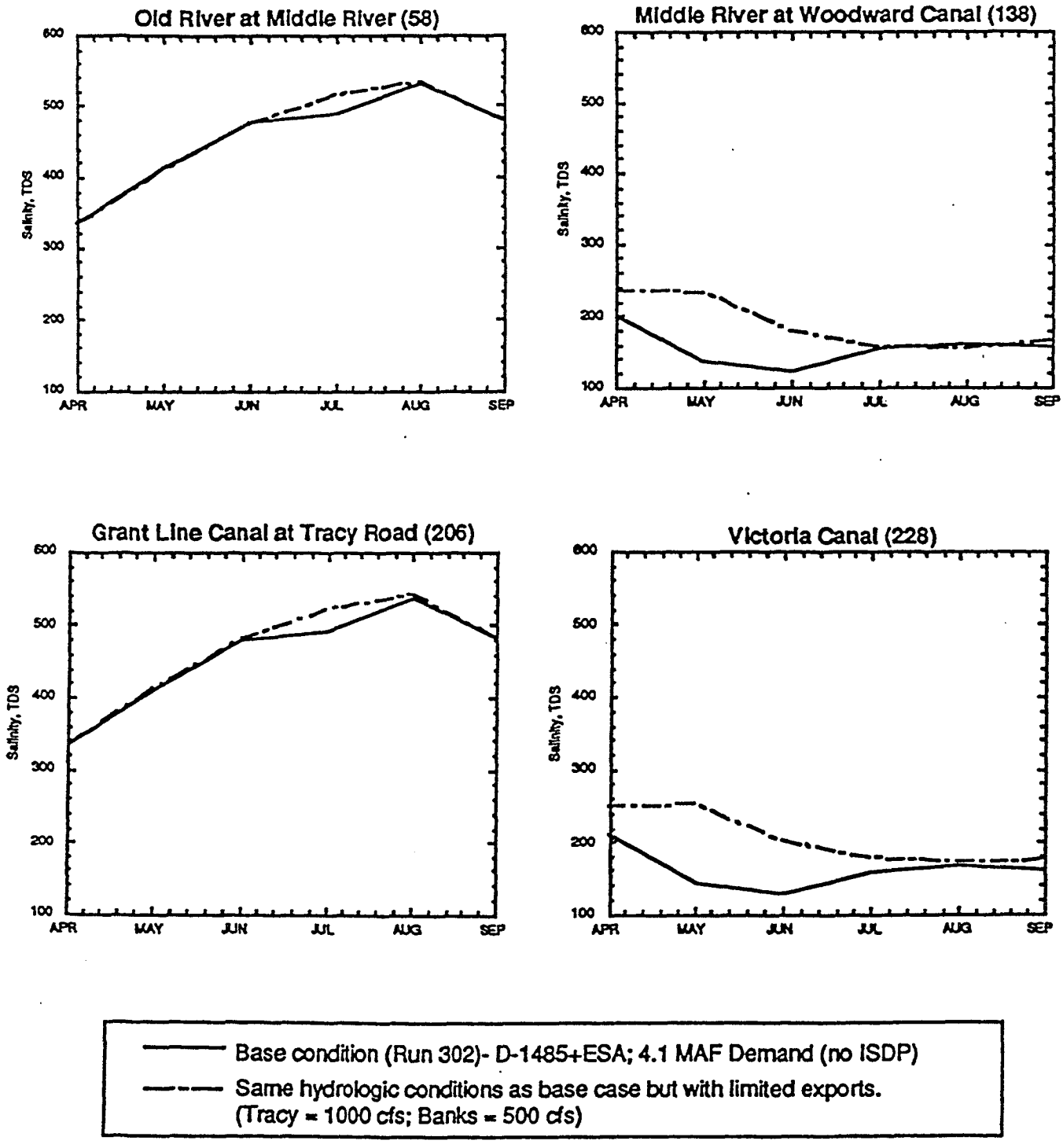


Figure III-5. Monthly Average Salinity Comparison of Limited Exports to a Base Condition During a Critical Year

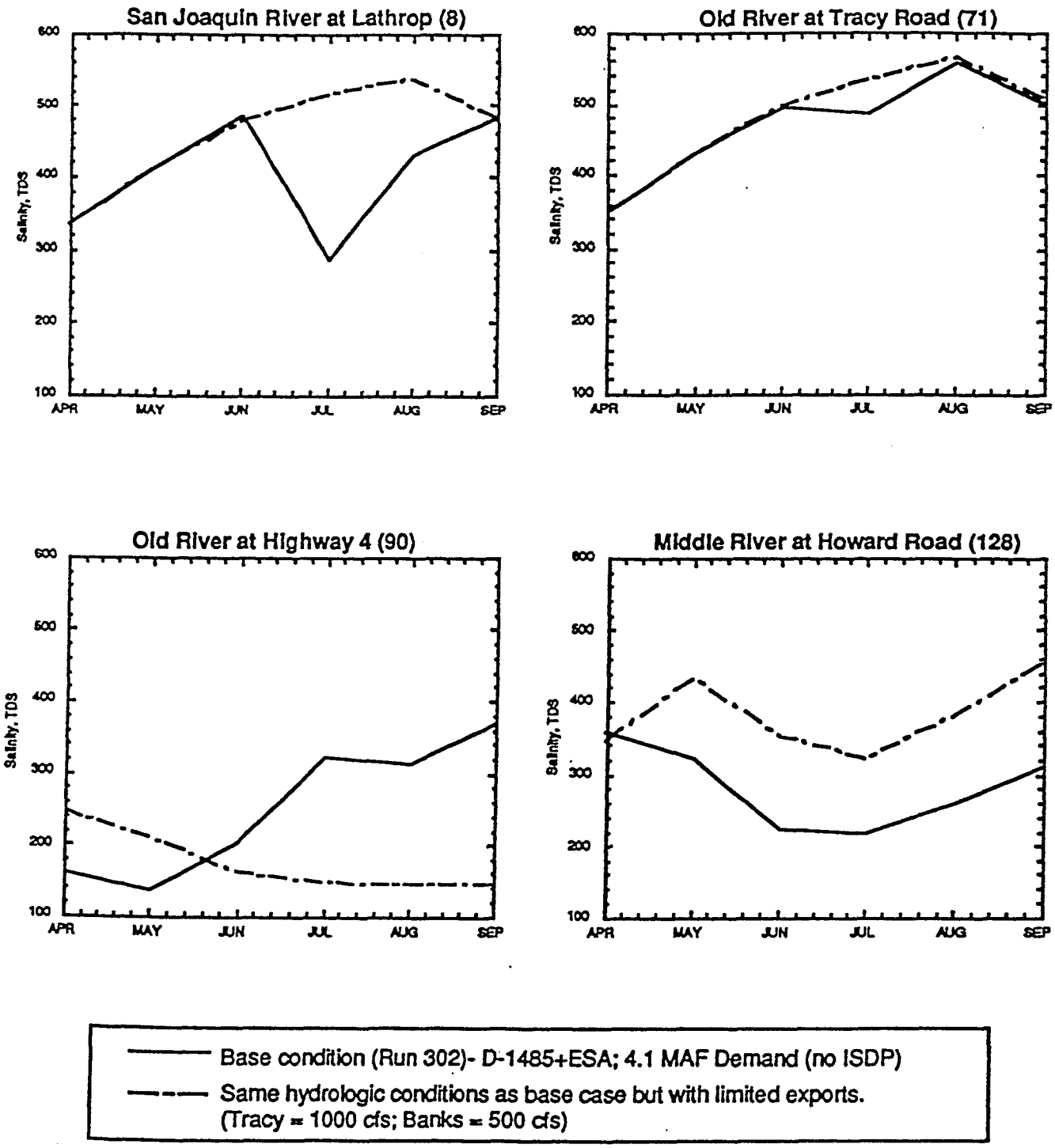


Figure III-5. Monthly Average Salinity Comparison of Limited Exports to a Base Condition During a Critical Year (concluded)

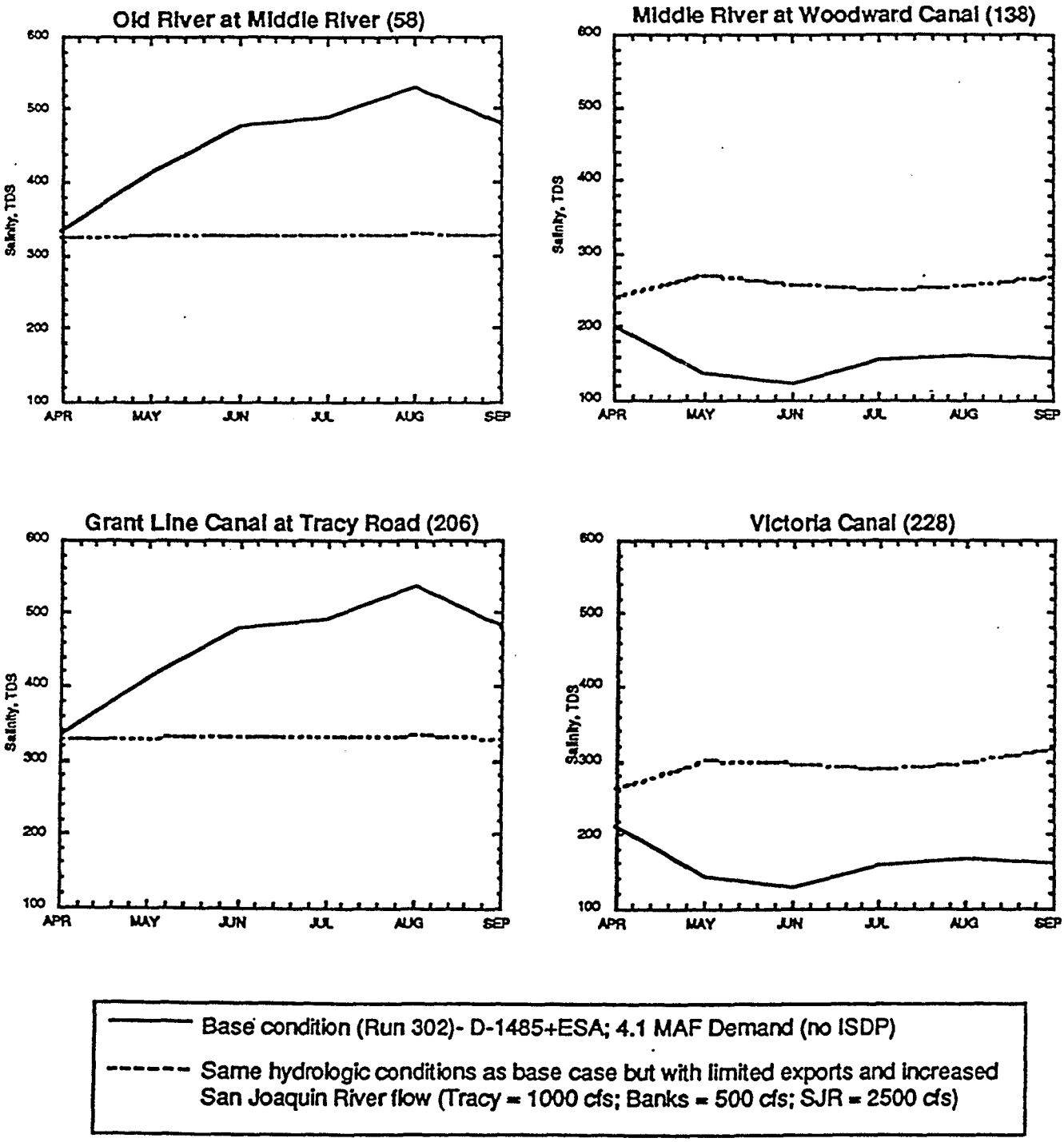


Figure III-6. Monthly Average Salinity Comparison of Increased San Joaquin River Flow and Limited Exports to a Base Condition During a Critical Year

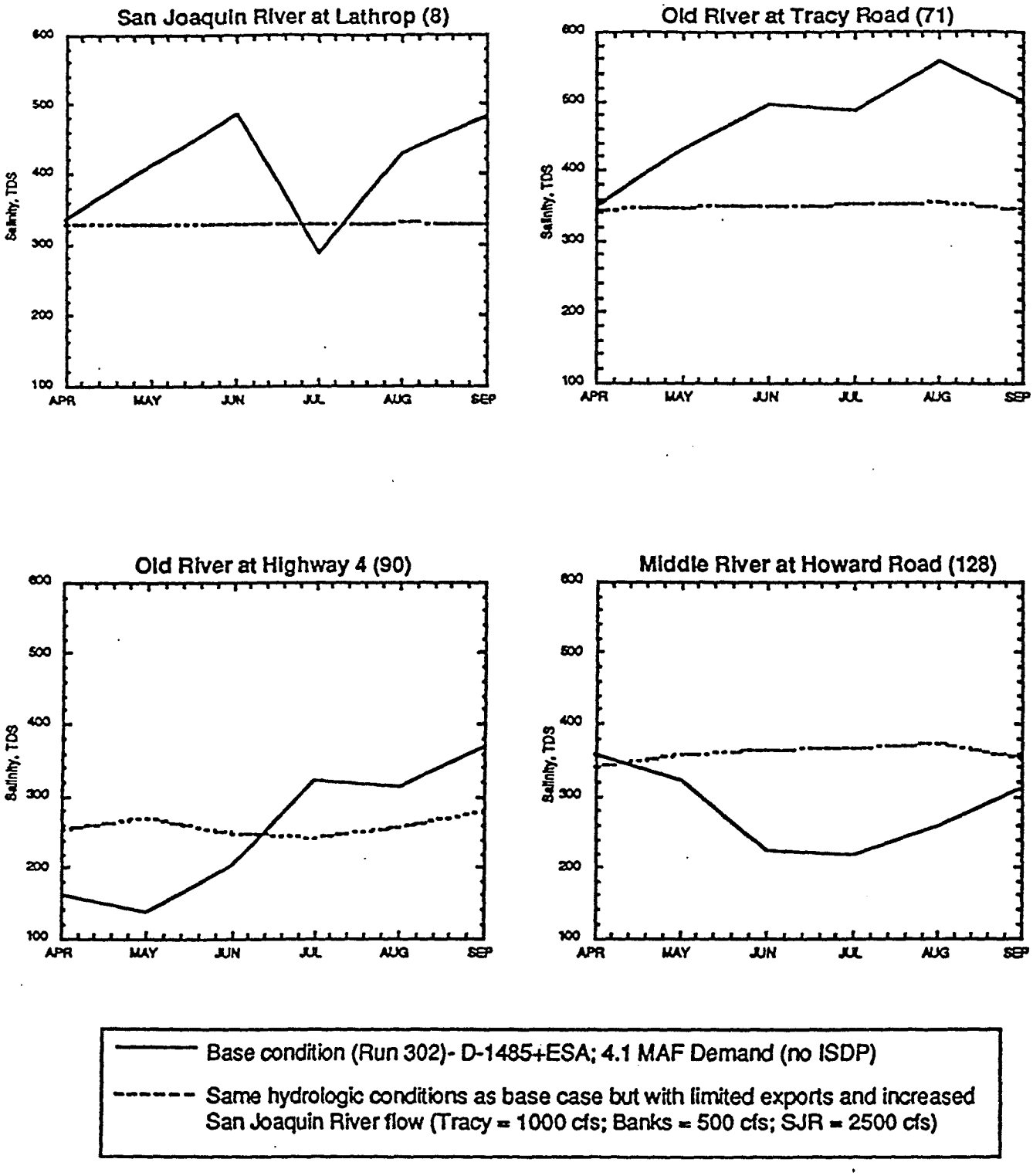


Figure III-6. Monthly Average Salinity Comparison of Increased San Joaquin River Flow and Limited Exports to a Base Condition During a Critical Year (concluded)

III-9b

Level 1 options are those which undergone extensive investigation and have been judged to have a high likelihood of being implemented by the Year 2020. Level 2 options are additional programs which could be implemented in the future, but require more extensive investigation and analyses before they can be further evaluated for feasibility. Both Level 1 and Level 2 options contain short-term and long-term measures.

Included among the Level 1 options are urban and agricultural water conservation, agricultural land retirement, urban water rationing and land fallowing/short-term water transfer programs. Level 2 options, comprises both additional supply and demand management options needing further feasibility studies, as well as additional storage and conveyance facilities. However, Level 2 options assume the implementation of all Level 1 options, which includes the proposed ISDP.

Using Level 2 options for demand reduction and management without implementation of Level 1 options would consider demand reduction and management programs with the following measures.

Agricultural Water Conservation. Increased agricultural water use efficiency.

Urban Water Conservation. Increased urban water use efficiency.

Land Retirement. Retirement of land with poor drainage disposal in west side San Joaquin Valley.

Water Transfer. Reallocation of supply for short- or long-term transfers.

Reclamation. Use of gray water, water recycling and desalting, reuse of agricultural brackish water.

San Diego County Water Authority Water Resources Plan. Plan includes water recycling, ground water development, and desalination of brackish water.

Santa Clara Valley Water Management. Increased water conservation programs, water reclamation, permanent water transfers, and additional long-term storage.

Hydrodynamics

This alternative is intended to improve water levels and circulation in the south Delta during the irrigation season. As such, it seeks to meet the objectives of the permanent barriers of the ISDP, and consists of two components: 1) reduction of CVP/SWP exports during the irrigation season (April through September), and 2) reduction of demand to compensate for export reductions.

Methods. A computer simulation was performed to assess the hydrodynamic impacts of a reduction in both the CVP and the SWP exports during the irrigation season. The irrigation season in the south Delta typically extends from April through September, with peak demands in July. Exports from the Banks Pumping Plant average 3,800 cfs in April, 5,000 cfs in August, and 3,600 cfs in September. Exports from the Tracy Pumping Plant average 3,200 cfs in April and 4,000 cfs from July through September. This existing average export schedule was compared to the reduced export schedule for this alternative totaling 1,500 cfs during the period from April through September. The reduced exports were shared between the CVP and SWP as follows: 1,000 cfs is pumped at Tracy and 500 cfs is pumped from Banks. For the screening-level analysis, a critically dry condition was used for the model boundary conditions. By inference from the modeling performed for the ISDP, the consequences observed during the critical year would be similar in timing during the other year types, but may differ in magnitude. The critical year sometimes produces the "worst-case" conditions, but not always.

The 4.1 million acre-feet (MAF) demand case modeled for the ISDP with DWRSIM was used as a baseline for evaluating the environmental consequences of this alternative. The Delta model (DWRDSM) was used to simulate changes in water levels and salinities evaluated at several south Delta locations. The Delta model run for the critical year without the ISDP was used to simulate the existing environment. The consequences of the alternative were simulated by reducing CVP and SWP exports during April through September. No other changes were made to the simulations performed for the ISDP. For example, the operation of Lake Oroville was kept the same, although the pumping restrictions could lead to a change in Oroville operation.

Hydrodynamic Effects. Water levels were predicted to increase throughout the south Delta with this alternative, but the increases are generally as much as one foot less than those modeled for the installation of barriers under the ISDP. With this demand reduction alternative, water levels in the south Delta would increase an average of 0.1 foot in April, 0.25 to 0.35 foot in July, and 0.1 to 0.2 foot in September in the representative critical year.

An assumption was made that there would be sufficient reduction in demand to compensate for the reduction in exports during the irrigation season, as described for Component 2 of this alternative. Under this assumption, exports would not increase during the period from October through March to compensate for the reduction in export during the irrigation season. If the demand reduction is successfully implemented, then the pumping schedule modeled by DWRSIM for the ISDP in the non-irrigation season (October through March) would not change under this alternative, and this alternative would not change any of the impacts that were modeled for the ISDP with respect to Delta inflow, Delta outflow, Delta exports, or operation of SWP reservoirs.

If there is an insufficient reduction in demand to compensate for the export limitations, then SWP and CVP operation may be altered in order to provide greater exports during the period from October through March. These potential changes were not modeled, but qualitatively they would likely be as follows. The export limitations during the irrigation season would likely lead to less releases from Lake Oroville (SWP) and Lake Shasta (CVP). Releases from both reservoirs would likely increase between October and March in order to allow greater exports during these months. These changes would probably be small during above normal and wet years since there would be limited additional export capability in the SWP system. During below normal, dry, and critical years, however, the changes in operation could be greater.

3. Increased Flows in the San Joaquin River, Modification of CVP/SWP Exports, Channel Dredging for Agricultural Diversions, Extending and/or Consolidation of Diversions, Screening of Diversions, Improvements to the Skinner Fish Salvage Facility, and Predation Control

This alternative was developed through discussions with staff from DFG, USFWS, NMFS, and the U.S. Environmental Protection Agency. It consists of six components: 1) management of combined CVP and SWP Delta exports, 2) increasing flows on the San Joaquin River, 3) consolidation and/or modification of agricultural diversions in the SDWA service area, 4) channel dredging, as needed, to permit the consolidated diversions, 5) screening of the consolidated diversions to minimize or eliminate fish losses, and 6) physical improvements to the SWP Skinner Fish Facility to improve the screening efficiencies of direct fish losses. Components 1-4 are intended to improve water levels and circulation during the south Delta irrigation season. Component 6 would allow greater exports, since

the existing fishery take limitation would be reached less often. All six of the components are described below.

Component 1. Management of CVP/SWP Delta Exports

The irrigation season in the south Delta typically extends from April through September, with peak demand occurring in July and August. Pumping at the Banks Pumping Plant (SWP) averages 3,800 cfs in April, rising to 5,000 cfs in August, and tapering to 3,600 cfs by September. Tracy Pumping Plant (CVP) averages 3,200 cfs in April and increases to 4,000 cfs from July through September. This component of the alternative is predicated on the assumption that a reduction in pumping at the Tracy and Banks pumping plants would significantly improve water levels and circulation in the south Delta.

To assess the effect of reducing CVP and SWP pumping, computer simulation analysis was performed which compared a base scenario with a scenario which assumed pumping at the Tracy and Banks pumping plants was restricted during the irrigation season to a total of 1,500 cfs -- 1,000 cfs at the Tracy Pumping Plant and 500 cfs at the Banks Pumping Plant. A critically dry condition was also assumed to examine the maximum amount of potential change that pumping restrictions could provide. The changes in water levels and salinities were evaluated at locations throughout the south Delta.

Figure III-2 (Page III-5) maps the locations used in the analysis. Figures III-3 and III-4 (Pages III-III-6 and III-7) are plots of the changes in water levels resulting from the pumping reduction. As shown in the plots, water levels increase 0.10 foot in April, 0.25 to 0.35 foot in July, and 0.10 to 0.20 foot in September. Figures III-5 and III-6 (Pages III-8 and III-9) are plots of the changes in salinity. For all locations except Old River at Highway 4 (#90), salinity remains the same or increases when pumping is reduced. The increases vary throughout the irrigation period. A maximum increase of 200 TDS is projected for the San Joaquin River at Lathrop in July. Salinity in Old River at Highway 4 (#90) is worse during April and May with reduced pumping however, it improves up to 200 TDS during June through September.

Component 2. Increasing Flows in the San Joaquin River

Water from the San Joaquin River is diverted by the SDWA for crop irrigation. The amount and quality of flow in the river affects the water quality and levels within south Delta channels. As a condition of the Framework Agreement (October 1986), the USBR has been making additional releases from New Melones Reservoir, on the Stanislaus River, to contribute to higher flows in the San Joaquin River near Vernalis. April flows on the San Joaquin River range from 2,400 cfs to 8,000 cfs. The range of flows narrows to 1,100 - 3,200 cfs during the period from July through September. This component of the alternative is predicated on the assumption that an increase in San Joaquin River flows during the agricultural season would significantly improve water levels and circulation in the south Delta.

In order to assess the effect of increasing the San Joaquin River flow, a computer simulation analysis was performed comparing a base scenario with one which assumed a 2,500 cfs flow in the San Joaquin River combined with the CVP and SWP pumping restrictions from Component 1 (pumping

at the Tracy and Banks pumping plants is restricted during the irrigation season to a total of 1,500 cfs -- 1,000 cfs at the Tracy Pumping Plant and 500 cfs at the Banks Pumping Plant). The analysis was done for a critically dry condition in order to show the maximum amount of improvement this combination could provide. The changes in water levels and salinities were evaluated at locations throughout the south Delta.

Figure III-2 (Page III-5) is a map of the locations used in the analysis. Figures III-7 and III-8 are plots of the changes in water levels resulting from the combined increased flow and pumping reduction. Except for the San Joaquin River at Lathrop (location #8) and Old River at Middle River (location #58), water levels increase from 0.10 foot to 0.20 foot in April, 0.25 to 0.55 foot in July, and 0.15 to 0.40 foot in September. Water level increases at the other two locations ranged from 0.20 foot in April to 0.6 to 1.1 foot in July, and 0.5 to 0.8 foot in September. Salinities are worse for Middle River at Woodward Canal (#138), Middle River at Howard Road (#128), and Victoria Canal (#228) with a maximum increase of 180 TDS in June and July. Salinities improve for Old River at Middle River (#58), Grant Line Canal at Tracy Road (#206), San Joaquin River at Lathrop (#8), and Old River at Tracy Road (#71) with a maximum reduction of 240 TDS in August.

In addition to the water supply reductions related to the pumping reductions and discussed under Component 1, additional releases from reservoirs on the San Joaquin River would be required to support the increased flows in below-normal, dry, and critically dry years. The increased releases amount to 200,000 acre-feet in below-normal years, and 300,000 to 400,000 acre-feet in dry and critical years.

Component 3. Consolidation of Agricultural Diversions

The purpose of this component is to relocate and reconfigure existing agricultural diversions in the south Delta service area so that such diversions would not be restricted by the current physical constraints affecting water supply in this area. This component assumes that a water distribution facility on Union Island is representative of one of several such facilities that would be needed in the south Delta. Similar facilities would be built on Fabian Tract and Upper and Middle Roberts Island. The following assumptions are made for the design:

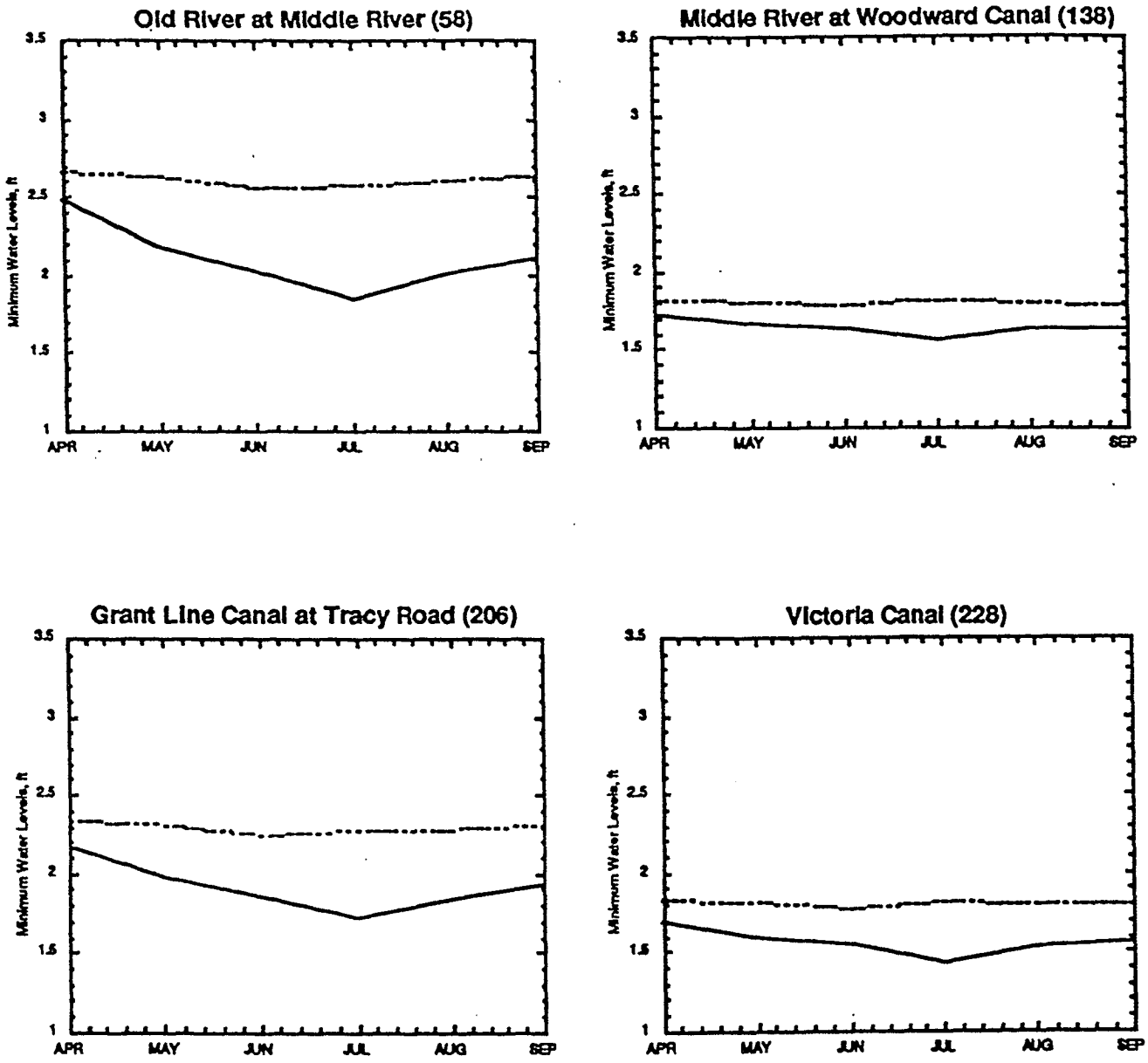
The total diversion must be continuous. All diverters can, at any given time, use the system and receive their required supply.

The flow must be uniform. The proposed system is designed with the assumption that the total diversion flows uniformly on the island. This assumption limits the size and capacity of the distribution facility.

Connections. Each landowner on the island is able to have a connection to the distribution system.

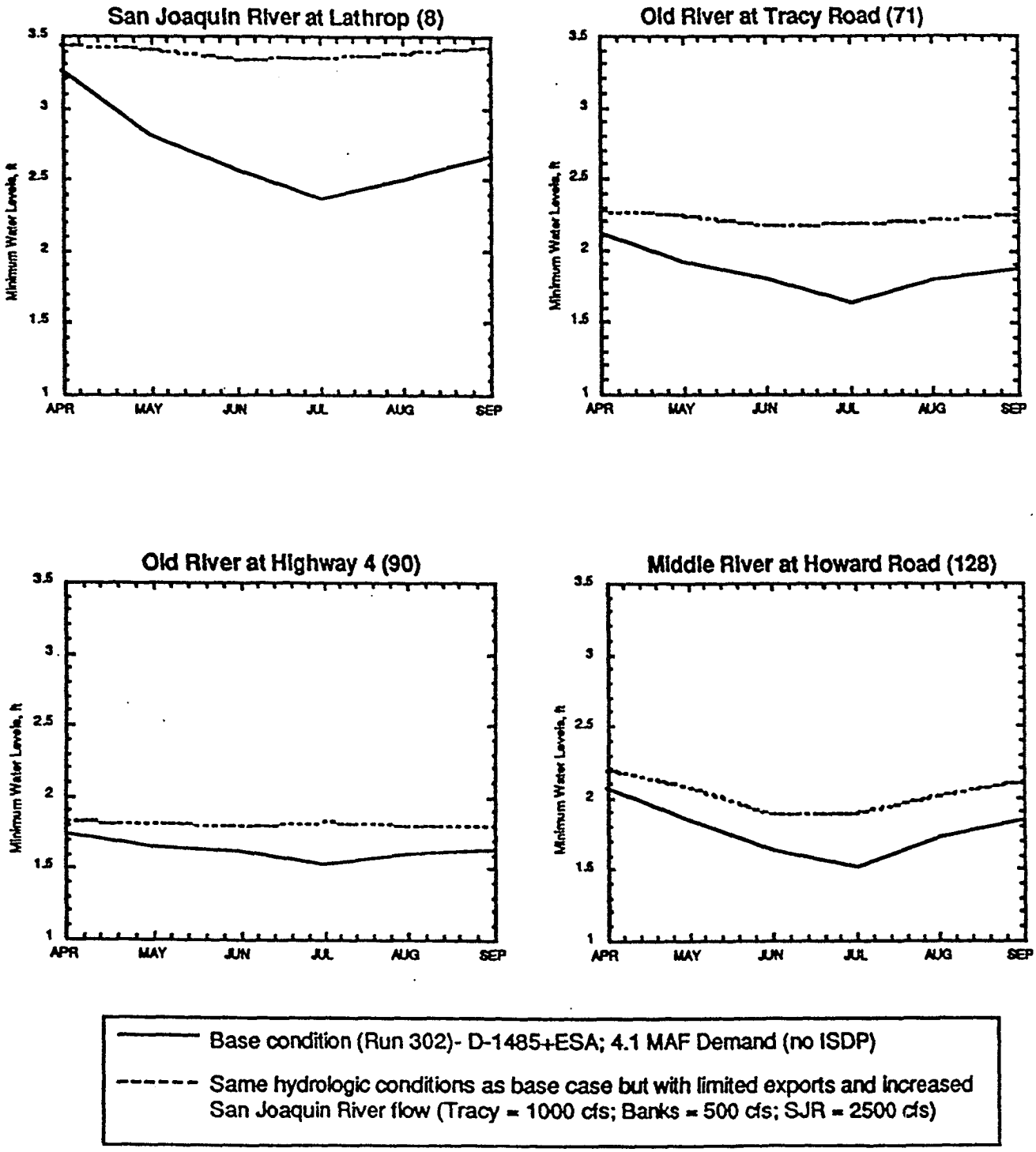
Physical facility. Distribution can be achieved by an overland facility, either by canal or pipeline.

Union Island, about 22,202 acres in size, is the largest of the three islands proposed for this study. Union East is about 9,622 acres in size and is located in Reclamation District 1. Union West is about 12,580 acres in size and is in Reclamation District 2. Union Island is bounded by Old and



* Minimum Water Level Above Mean Low Low Water (MLLW).

Figure III-7. Minimum Water Level* Comparison of Increased San Joaquin River Flow and Limited Exports to a Base Condition During a Critical Year



* Minimum Water Level Above Mean Low Low Water (MLLW).

Figure III-8. Minimum Water Level* Comparison of Increased San Joaquin River Flow and Limited Exports to a Base Condition During a Critical Year

Middle rivers, and North and Grant Line canals. Two different distribution systems were investigated for this island, an open channel and a pipeline.

The pipeline system is supplied by screened pumps at four locations. The locations were chosen to consolidate all diversions along Middle River on the north edge of Union Island, along Middle River on the northeast edge of Union Island, along North Canal on the northwest edge of Union Island, and along Grant Line Canal on the south edge of Union Island. It also includes two in-line pumps coupled with approximately 30 miles of 14-foot diameter steel, concrete-lined, epoxy coated pipe to carry a maximum of 450 cfs. Turn-outs from this system would be provided to the existing system of irrigation ditches currently being used on the island. The construction period would last about 36 months with a construction crew of about 25 people. The estimated cost of this system is $223 million. This method of distribution was not evaluated further because of its extremely high cost.

The open channel system has a maximum capacity of 450 cfs. It is supplied by the four screened pumps discussed previously. The total length of the proposed concrete-lined channel is about 30 miles. The channel would be built using the existing levee as one of its sides. Its other side would be constructed using 3.5 million cy of imported fill material. Approximately 40,000 cy of concrete would be required to line the channel. The maximum top width of the channel is 24 feet. The channel would extend between 50 to 100 feet beyond the toe of the existing levee.

Turn-outs from this open channel system would be provided to the existing system of irrigation ditches being used on the island. The construction period would last approximately 30 months with a construction crew of about 15 people. The estimated cost of this system is $45 million.

Similar open channel systems would be built on Fabian Tract and Middle and Upper Roberts Island. The maximum capacity of the channels is 140 cfs for Fabian Tract and 375 cfs for Middle and Upper Roberts Island. The cost would be $10 million and $27 million respectively, bringing the total cost of the three distribution systems to $82 million.

Component 4. Channel Dredging for Consolidated Diversions

The exact amount and location of channel dredging which would be needed to construct operational water distribution facilities in the south Delta is unknown. It depends upon the specific site conditions of the pumps and their pumping rates.

The cost of dredging material can vary from a low of about $2.50 per cy for hydraulic dredging to about $20.00 per cy for clamshell dredging. This does not include the cost of placing the material for drainage and storage for later use.

For this component, a conservative estimate of total dredging is used -- 200,000 cy of material which results in cost estimates from $500,000 to $4 million.

Component 5. Screening of Consolidated Diversions

The screening of the proposed consolidated diversions is incorporated into Component 3. The cost of screening the four pumps supplying the open-channel distribution system is estimated at $45,000

per pump, for a total cost of $180,000. This may be underestimated because the potential costs associated with screening the Delta diversions are largely unknown. The cost for screens on Bacon and McDonald islands was approximately $2,000 per cfs. In addition, there are operation and maintenance costs in seasonally installing and removing the screens, keeping them clean, and maintaining the structural integrity of the intake and screen.

Component 6. Improvements to Skinner Fish Protection Facility

The John E. Skinner Fish Protective Facility (fish facility), a segment of the SWP, is located in southeastern Contra Costa County near Byron, California. In 1968, the fish facility began to salvage millions of fish out of the intake channel to the Banks Pumping Plant for release back into the Sacramento/San Joaquin River Delta. The fish facility is staffed by DWR and DFG (DFG 1981).

Several evaluation studies are proposed for the fish facility. The findings and recommendations from these studies would be used to improve the facility, with physical improvements, improved operational criteria, better procedures for handling fish, and reducing the effects of predation within the facility.

Funding to identify and implement improvements to the fish facility is available through the Interagency Ecological Program and through funding of DFG's salvage-operations staff by DWR's Delta Field Division. These activities may be incorporated as activities under Category III of the December 15, 1994, agreement between federal and State agencies which identifies a comprehensive, coordinated package of actions to protect the San Francisco Bay and Delta. As part of the agreement, the parties committed to activities during 1995-1997 to protect the Bay-Delta Estuary ecosystem which are estimated to cost $60 million annually. An initial financial commitment of $10 million annually for the next three years has been made by the water user community. Improvements defined by these studies can be completed by utilizing current funding mechanisms, potential funds made available by the Category III activity funds, or as part of a mitigation package for the ISDP.

Hydrodynamics

This alternative consists of six components: 1) reduction of CVP/SWP exports during the irrigation season (April through September), 2) increase flows in the San Joaquin River to a minimum of 2,500 cfs, 3) consolidate and/or modify agricultural diversions in the SDWA service area, 4) dredge channels as necessary to accommodate the consolidated agricultural diversions, 5) screen the consolidated diversions to minimize or eliminate fish losses, and 6) improve the screening efficiency of the SWP Skinner fish facility. Components 1, 2, 3, and 4 are intended to improve water levels and circulation in the south Delta during the irrigation season, and hence meet the objectives of the permanent barriers component of the ISDP. Components 5 and 6 are intended to reduce the direct loss of fish as a result of water diversions. Component 6 would allow greater exports, since the existing fishery take limitation would be reached less often.

Methods. The impacts of this alternative on Delta hydrodynamics are evaluated by the same type of screening-level computer simulation as was presented for the alternative involving a reduction of CVP/SWP demand and exports. The base model is the 4.1 MAF demand case modeled with

DWRSIM. The impacts of this alternative are evaluated by modifying this model in two ways: 1) CVP/SWP exports are reduced during the irrigation season to 1,500 cfs (Component 1), exactly as they were for the CVP/SWP export reduction and demand management alternative; and 2) flows on the San Joaquin River are increased to a minimum of 2,500 cfs for April through September (Component 2). For the screening-level analysis, the representative critically dry year was used for the model boundary conditions. By inference from the modeling performed for the ISDP, the consequences observed during the critical year would be similar in timing during the other year types, but may differ in magnitude. The critical year sometimes produces the "worst-case" conditions, but not always.

This alternative does not specify that there would be reductions in demand for CVP/SWP water to accommodate the export reductions and flow increases. As a result, a more thorough simulation would call for increased exports during the non-irrigation season (October through March) to the maximum extent allowed by regulations and reservoir storage capacities. The screening-level computer simulation used in this impact assessment only considers the irrigation season (April through September); impacts during the non-irrigation season are only treated qualitatively.

The irrigation season in the south Delta typically extends from April through September, with peak demands in July. Exports from the Banks Pumping Plant average 3,800 cfs in April, 5,000 cfs in August, and 3,600 cfs in September. Exports from the Tracy Pumping Plant average 3,200 cfs in April and 4,000 cfs from July through September. This existing average export schedule is compared to a reduced export schedule totaling 1,500 cfs during the period from April through September. The reduced exports are shared between the CVP and SWP as follows: 1,000 cfs is pumped at Tracy and 500 cfs is pumped from Banks. To model increased flows in the San Joaquin River, flow in the river was raised to a minimum of 2,500 cfs during the irrigation season in the model. These higher flows would be provided by increased releases from the USBR's New Melones Reservoir on the Stanislaus River.

The 4.1 MAF demand case modeled for the ISDP with DWRSIM was used as a baseline for evaluating the environmental consequences of this alternative. The Delta model (DWRDSM) was used to simulate changes in water levels and salinities, evaluated at several south Delta locations. The Delta model run for the critical year without the ISDP was used to simulate the existing environment. The consequences of the alternative were simulated by reducing CVP and SWP exports during April through September. No other changes were made to the simulations performed for the ISDP. For example, the operation of Lake Oroville was kept the same, although the pumping restrictions could lead to a change in Oroville operation.

Hydrodynamic Effects. Water levels are increased throughout the south Delta with this alternative. According to the modeled results for the representative critical year, water levels increase from 0.10 foot to 0.20 foot in April, 0.25 to 0.55 foot in July, and 0.15 to 0.40 foot in September. Water levels increase a greater amount in the San Joaquin River at Lathrop and in Old and Middle rivers. Increases at these two locations range from 0.20 foot in April to 0.6 foot to 1.1 feet in July, and 0.5 to 0.8 foot in September.

This alternative calls for a considerable amount of channel dredging in the Delta. The locations have not been specified, hence a detailed consideration of the potential changes in Delta circulation is not possible. The consequences can be qualitatively specified as follows. The consolidated diversion plan calls for modifications to the channels adjacent to Union Island, Fabian Tract, and

Middle and Upper Roberts Island. These islands are distributed throughout the south Delta, and as such, channel dredging should also be distributed throughout this area. The channel modifications should not have a significant impact on Delta circulation since the changes are not concentrated on a single channel.

The alternative calls for consolidating the agricultural diversions for Union Island, Fabian Tract, and Middle and Upper Roberts Island. Currently, agricultural diversions are below about 20 cfs and are not concentrated in specific areas. Under this alternative, these diversions would be consolidated to approximately four per island, with the following diversion capabilities: 1) Union Island - 450 cfs; 2) Fabian Tract - 140 cfs; and 3) Middle and Upper Roberts Island - 375 cfs per section of island. The consequences of increased withdrawals from the Delta channels adjacent to the pumps have not been quantitatively modeled, but they would qualitatively be as follows. The increased flow rates could lead to increased scour potential in the vicinity of the pumps and in nearby channel segments. There could be local changes to Delta circulation patterns, such as localized reverse flow.

If there is no reduction in demand to compensate for the export limitations, then SWP and CVP operation may be altered in order to provide greater exports during the period from October through March. Since demand reduction is not explicitly included in this alternative, as it is for the alternative involving CVP/SWP reduction in demand and exports, such a change in operations is probable in order to meet existing demand. In addition, by improving the screening efficiency of the SWP fish facility, the existing fishery take limitation would be reached less often and greater volumes of water could be exported. These potential changes were not quantitatively modeled, but qualitatively they would likely be as follows. The export limitations during the irrigation season would likely lead to less releases from Lake Oroville (SWP) and Lake Shasta (CVP). Releases from both reservoirs would likely increase between October and March in order to allow greater exports during these months. The changes in release schedule would lead to changes in river flow rates on the Feather River and the Sacramento River, and to changes in north and central Delta circulation patterns and Delta outflow. These changes would probably be small during above normal and wet years since there would be limited additional export capability in the SWP system, hence less need to alter reservoir operations from those modeled for the ISDP. During below normal, dry, and critical years, however, the changes in operation could be greater. The consequences of the changes in operation would be limited to the existing regulatory constraints on flow and water quality.

If the demand for exports is reduced to accommodate this decrease in exports, then the pumping schedule modeled by DWRSIM for the ISDP in the non-irrigation season (October through March) would not change under this alternative. If this is the case, then this alternative would not result in any changes other than those modeled for the ISDP with respect to Delta inflow, Delta outflow, Delta exports, or operation of SWP reservoirs.

4. ISDP with an Additional Clifton Court Forebay Intake at Italian Slough

This alternative would include all of the proposed components of the ISDP, with the addition of a new intake at Italian Slough. Accordingly, this alternative would include two proposed intakes, one at Italian Slough and one at the northeastern corner of Clifton Court Forebay (Figure III-9). The additional intake at Italian Slough is described below.

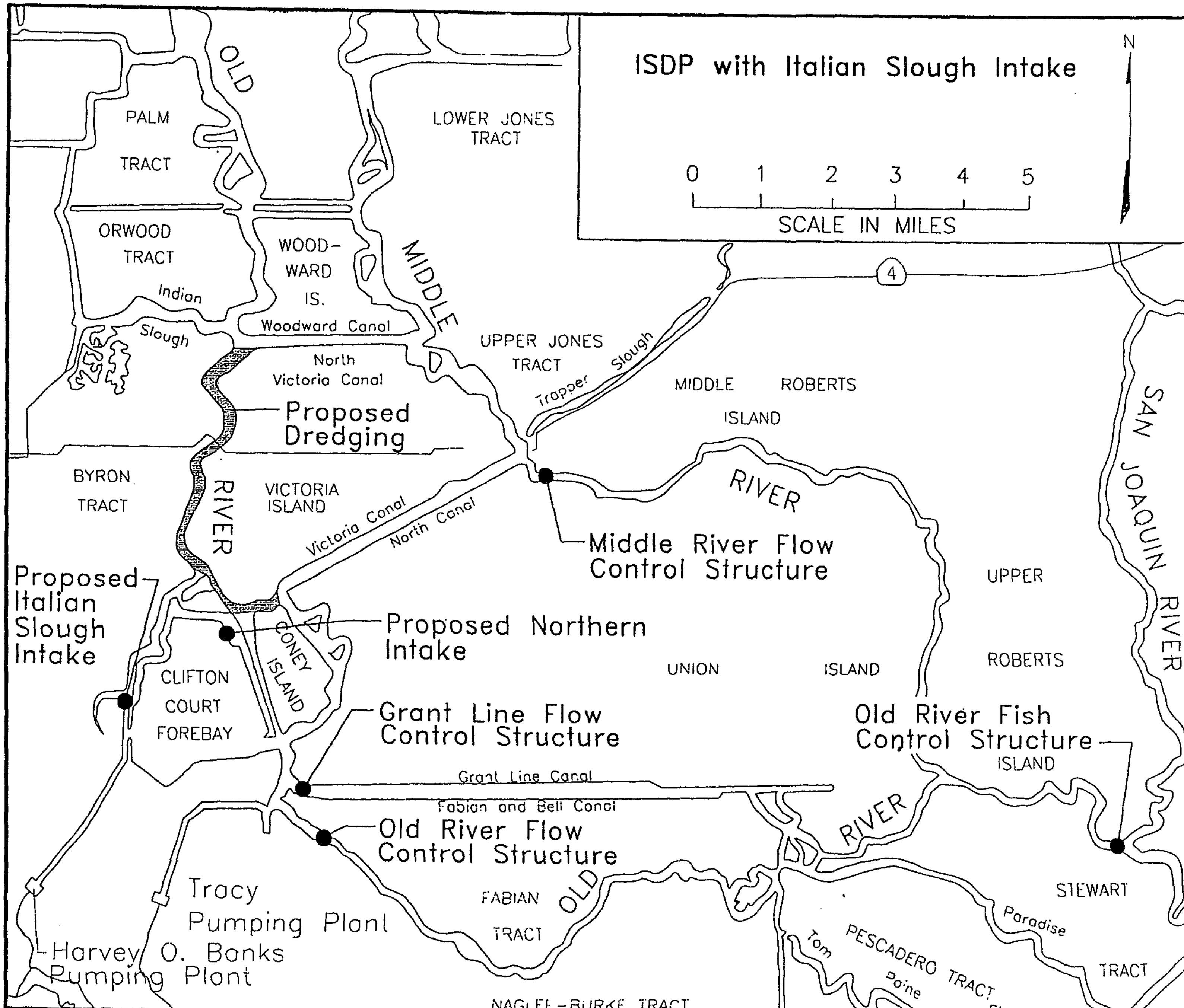


Figure III-9. ISDP with Intake at Italian Slough

Facility Description

The additional intake facility would include a four-bay flashboard structure which would allow water from Italian Slough to be diverted into the intake channel of the California Aqueduct. The flashboard intake structure would consist of four 20-foot-wide bays which are 25 feet in height. This structure includes flashboard slots and a 24-foot-wide vehicular bridge. Steel flashboards would be placed in the slots when the structure is not in use.

Because of the limited hydraulic capacity of Italian Slough, Delta diversions are physically limited to approximately 2,300 cfs or 4,560 acre-feet per day. Therefore, diversions from Italian Slough would only occur during periods of very low SWP Delta exports. Water exported at Banks Pumping Plant via an Italian Slough diversion would have a much shorter residence time than water diverted from Old River via the existing Clifton Court Forebay. Because of the decreased residence time, predation of fish may also decrease and screening efficiencies at the Skinner Fish Facility may increase. Under these conditions, direct losses of fish due to SWP Delta exports may decrease if diversions are made via an Italian Slough intake.

To prevent water in Clifton Court Forebay from mixing with water diverted from Italian Slough, a temporary rock dam would be placed in the 630-foot-long opening which connects the forebay to the intake channel. Approximately 23,000 cy of rock must be placed in the breached section to isolate the forebay when the intake structure is opened. The rock material must be removed and stored when the forebay is in use.

The construction period for the Italian Slough intake would be about 18 months. Construction of the intake would involve constructing an earthen plug (i.e., cofferdam) with the intake channel, pumping water out of the construction area, excavating material from the construction area, constructing concrete and formwork for the structure and bridge, fabricating the steel flashboards, relocating the existing road, and removing the earthen plug. A maximum of 30 to 40 workers would be employed during construction. The estimated cost of construction is $3 million. Operation and maintenance cost, not included in the $3 million, would be an additional yearly expense. A permit under Section 404 of the federal Clean Water Act would be required before the Italian Slough intake could be constructed.

The Italian Slough intake structure would be operated when Clifton Court Forebay was not in use. The opening that connects the forebay to the intake channel would be filled with rock. This breach would be filled either using a barge that would sit in Italian Slough or using trucks. The time required to place or remove the rock dam would be from four to six weeks. Once the temporary rock dam was in place, the flashboards would be removed from the intake structure. The intake structure would remain open and water would be pumped as allowed by tide levels. When the tides prevented pumping, the structure would remain open. When higher pumping was needed, the rock dam would be removed and the flashboards reinserted allowing access to the forebay.

Hydrodynamics

This alternative differs from the ISDP by providing an additional intake at Italian Slough. Owing to capacity limitations of Italian Slough, the intake would only be used when export pumping rates

are less than 3,000 cfs. The alternative does not change the amount of increased export capability and it assumes that demand is the same as for the ISDP.

Since export capability is not changed under this alternative, it is likely that the pumping schedule modeled by DWRSIM for the ISDP would not change. If this is the case, then this alternative would not cause any changes other than those modeled for the ISDP with respect to Delta inflow, Delta outflow, Delta exports, or operation of SWP reservoirs.

The effects upon the existing Within Delta flows for this alternative would differ from those modeled for the ISDP in that changes in velocity may cause localized scour near the intake and in Italian Slough. No modeling of the magnitude of the increases has been conducted, but increases of above 3 feet per second may occur under some conditions. The effects of the barriers would be similar under this alternative to those modeled for the ISDP.

5. ISDP without the Northern Intake, and with an Expanded Existing Intake

This alternative would include all of the proposed components of the ISDP, except the existing Clifton Court Forebay intake would be expanded to accommodate the additional flow, instead of constructing a new intake either at Italian Slough or at the northeastern corner of Clifton Court Forebay (Figure III-10). Dredging would be required in West Canal to accommodate flow into the expanded intake.

Facility Description

The existing intake structure, which regulates flow into the forebay and isolates the forebay from the Delta, consists of five 20-foot-wide by 25-foot-high radial gates, housed in a reinforced concrete gate bay structure. A riprapped channel 1,000 feet long with a 300-foot base width connects the control structure with West Canal. The existing channel and structure can divert a maximum flow of 16,000 cfs into the forebay.

The proposed modification adds an identical intake structure south of the existing intake. The maximum capacity of the expanded intake facility is 30,000 cfs. To maintain the average velocity of 3 feet per second in the approach channel, the base width of the new channel would be increased from its present width of 300 feet to 560 feet. Increasing the base width of the approach channel would require relocating the southeast levee along the existing approach channel approximately 260 feet inland. A 230-kV transmission line which is near the levee and owned by the USBR would also require relocation. A portion of the southern forebay embankment near the existing intake would also be relocated. A building housing the controls for the facility would be placed between the two gate structures.

Construction of the new intake would include the placement of a cellular cofferdam in the forebay; excavation for the intake structure; concrete construction of the five bays, vehicular bridge, and hoist platform; concrete construction of inlet and outlet transitions; fabrication of the five radial gates; construction of a control building; levee embankment; and channel excavation. It is anticipated that construction would occur over 30 months. At the peak of construction, the work crew is expected

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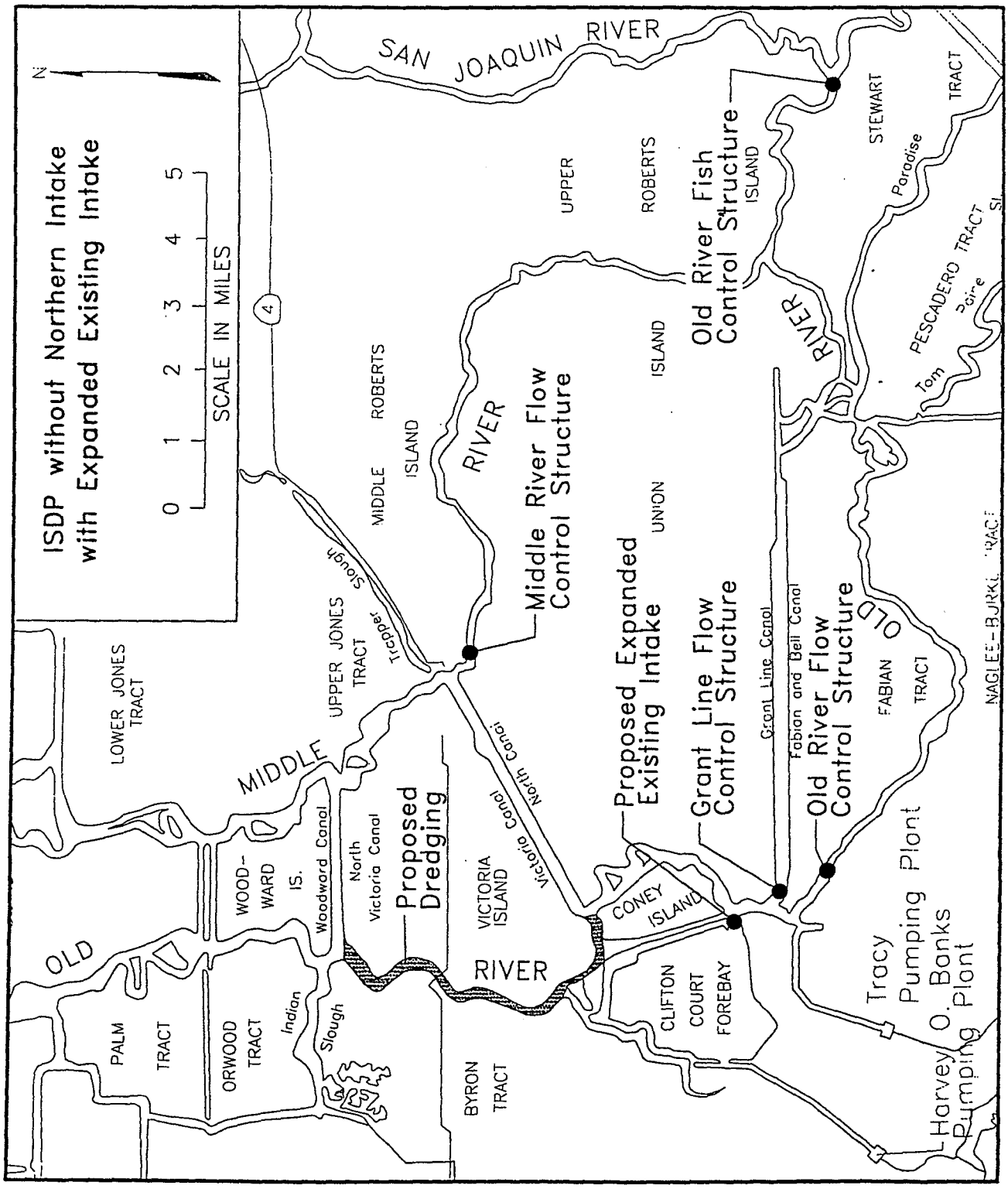

Figure III-10. ISDP withoutNorthern Intake, with an Expanded Existing Intake

to consist of 50 to 70 people. Access to the construction site would be from Highway 4 to the SWP Skinner Fish Facility and along the road on the southern embankment of the forebay.

The location and extent of any required channel enlargement is currently being analyzed. It is anticipated that enlargement would be required in West Canal to maximize the full pumping capacity at Banks Pumping Plant and avoid scouring the channel.

Hydrodynamics

This alternative differs from the ISDP by eliminating the new northern intake and by expanding the existing intake. The alternative does not change the amount of increased export capability, and it assumes that demand is the same as for the ISDP.

Since export capability is not changed under this alternative, it is likely that the pumping schedule modeled by DWRSIM for the ISDP would also not change. If this is the case, then this alternative would not create any changes other than those modeled for the ISDP with respect to Delta inflow, Delta outflow, Delta exports, or operation of SWP reservoirs.

The impacts to existing Within Delta flows for this alternative would differ from those modeled for the ISDP as follows: 1) changes in velocity may cause localized scour near the enlarged intake, and 2) there would be minor changes in circulation patterns in the south Delta from those modeled for the ISDP. These issues are discussed in more detail below.

The flow velocities in West Canal and Old River would be changed by the enlarged intake. No detailed modeling has been performed to evaluate the change, but velocities in channels may exceed the 3 feet per second likely to induce scouring.

There would be a change in local south Delta circulation patterns under this alternative as compared to the ISDP. When the flow barriers are not operating, channel velocities in the reaches of Middle River, Grant Line Canal, and Old River that are upstream of the barriers would be greater using the enlarged intake of this alternative. When the barriers are operational, water surface elevation may decrease and velocities may increase downstream of the barriers on Old River near the Delta Mendota Canal and in Grant Line Canal. The velocities may exceed the 3 feet per second likely to induce scouring. When the barriers are operational, the circulation patterns should be similar under this alternative and the ISDP.

Other than the impacts described in the preceding paragraph, the effects of the barriers would be similar under this alternative to those modeled for the ISDP.

6. ISDP without the Northern Intake, and with an Intake at Italian Slough

This alternative would include all of the proposed components of the ISDP, except the new intake would be constructed at Italian Slough instead of at the northeastern corner of Clifton Court Forebay (Figure III-11). While this alternative was developed in consultation with several resource agencies, upon review, the intake at Italian Slough would provide insufficient capacity to support the

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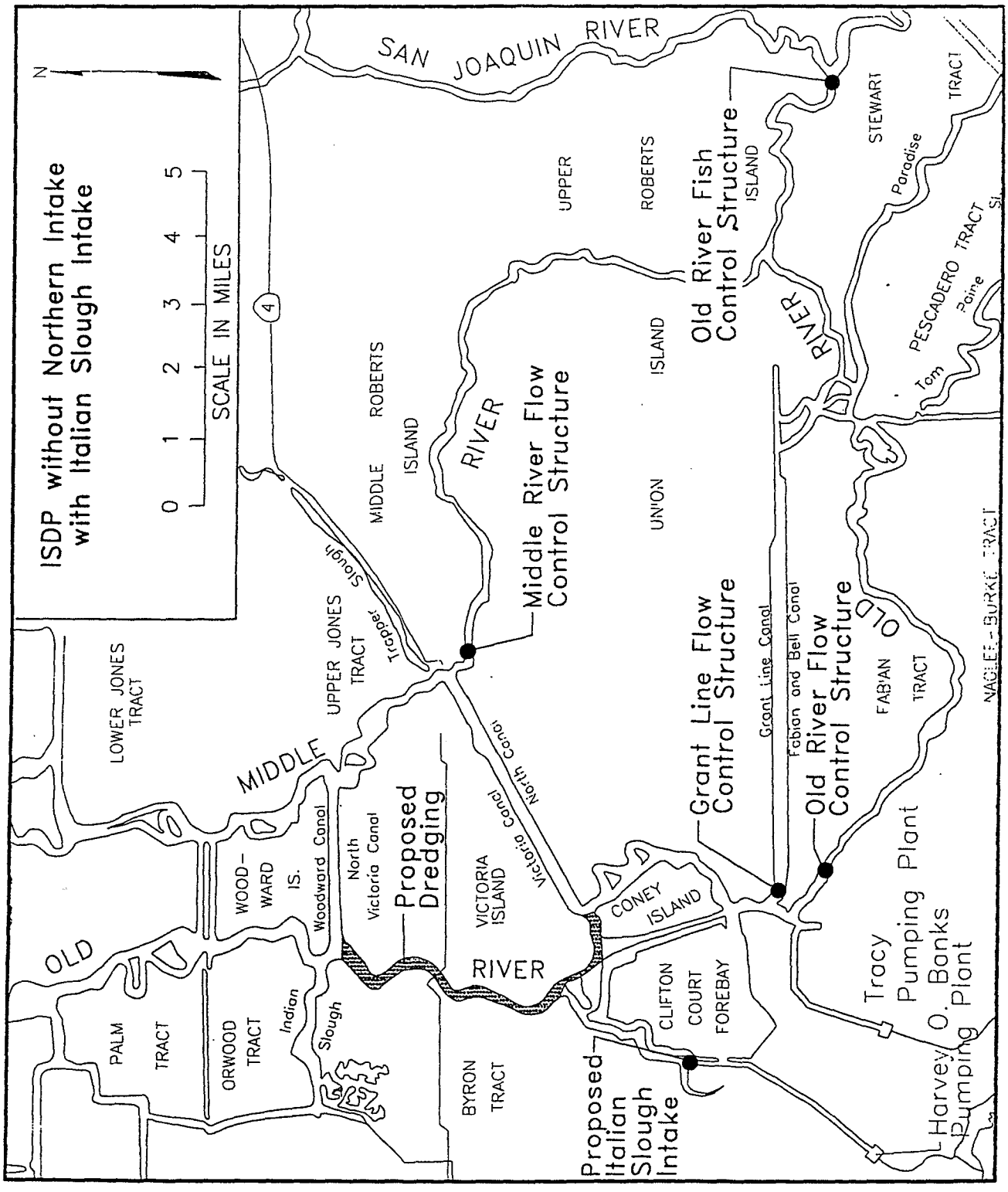

Figure III-11. ISDP withoutNorthern Intake, with an Intake at Italian Slough

development of the ISDP. The limited hydraulic capacity of Italian Slough would limit diversions to 2,300 cfs or 4,560 acre-feet per day. With this intake, ISDP operations would be limited to periods of very low SWP Delta exports. Upon reflection, DWR believes the alternative of the ISDP with both a new northern intake and an intake at Italian Slough, described above, provides the evaluation requested by the resource agencies, and assures compliance with the CEQA and NEPA guidelines regarding the consideration of a reasonable range of alternatives. No further evaluation is provided for an alternative that includes an intake only in Italian Slough.

7. No Action (Maintain Existing Conditions)

This alternative would involve the maintenance of the environmental conditions as they exist at present. The ISDP would not be approved or constructed. The potential adverse environmental effects of the ISDP would not occur, nor would the potential water supply, water quality, and environmental benefits occur.

This alternative differs from the ISDP by maintaining conditions as they exist at present. The Delta environment and water project operations as they have existed from 1978 through 1991 are described as the existing conditions in Section 4.1 of the Draft EIR/EIS (Entrix 1995). That section provides a representation of the variability in the existing environment, given changes in climate, changes in demand, and changes in regulatory constraints. In order to describe the existing conditions as they would be from now into the future, it is important to minimize the effects of this historic variability in demand and regulatory constraints. For example, in 1990, the regulatory constraints were changed to include consideration of endangered species in water project operations, so there are in fact only two years of data available to describe the No-Action Alternative under the existing demand and regulatory conditions. These years, 1991 and 1992, were critical year types and would not provide a complete picture of what the existing demand and regulatory conditions would produce during the other water year types. For this reason, a simulation of water project operations and the Delta environment was made to augment the description of the existing environment in evaluating the consequences of the No-Action Alternative. The existing demand on the SWP was set at 3.6 MAF to provide a base case study; this same model run was used as a baseline in evaluating the impacts of the ISDP (Existing Demand Case Study).

This No-Action Alternative differs from the ISDP by maintaining current maximum pumping capacity. In addition, this alternative does not require construction of barriers or dredging within the south Delta. The resulting differences in hydrodynamic elements, such as Delta inflow, Delta outflow, Delta exports, and within-Delta flows between this alternative and the ISDP are described in Chapter II of this Biological Assessment.

The full pumping capabilities of the Banks Pumping Plant would not be utilized in this alternative and therefore changes to Delta outflow and within-Delta flows would occur. The changes in south Delta circulation resulting from the operation of barriers would not occur under this alternative.

The benefits of increased flexibility in water project operations associated with the ISDP would not be realized in this alternative. Under this No-Action Alternative, SWP operations would be narrowly constrained to meet both regulatory and demand requirements while maintaining pumping at existing levels.

The absence of barriers in this alternative means that more water from the San Joaquin River would enter the south Delta and that water levels and circulation would remain restricted. Other benefits of the barriers, such as diversion of aquatic resources from the pumping area and improvements in the quality of water pumped, would be lost under this No-Action Alternative.

Summary of Assumptions For No-Action Alternative

The SWP and CVP would continue to coordinate their operations under the following criteria:

- SWRCB Water Rights/December 15, 1994 State-Federal Principles of Agreement
- Federal and State Endangered Species Act
- Central Valley Project Improvement Act of 1992
- Safe Drinking Water Act
- Delta Flood Protection Act of 1988
- Delta Protection Act of 1992

Two new off-stream water supply facilities would be constructed in the upcoming years: the 800,000 acre-foot Domenigoni Valley Reservoir and the 100,000 acre-foot Los Vaqueros Reservoir. In addition, reclamation programs, conjunctive use programs, and conveyance facilities would play key roles in managing California's future water supply. In addition to off-stream storage projects, other important water supply programs and projects include reclamation programs, conjunctive use programs, and conveyance facilities.

Together, however, these measures would not be able to ensure an adequate water supply for a growing California in the future. By the Year 2020, in an average water year, the state would still experience shortages between 2.8 MAF to 4.8 MAF in average years, and 3.9 to 5.9 MAF in drought years. In the SWP service area, shortages are predicted in the Year 2020, where a 1.06 MAF deficit would occur in average years, and a 2.7 MAF deficit would occur in drought years.

8. No Action (Maintain Conditions as they would Exist in the Future)

This No-Action, Future Case Alternative involves conditions, policies, laws, ordinances, rules, regulations, programs and projects that exist or would likely be developed in the absence of the ISDP, leading to a determination of the likelihood that California's future water requirements would be met without the ISDP. This alternative includes a discussion of projected water use estimates, the current institutional framework, existing water facilities and water programs, programs and policies with future facilities, and projects which are judged to have a high likelihood of being constructed.

It should be noted that under this No-Action, Future-Case Alternative the construction of the proposed ISDP facilities would not occur. Therefore, impacts associated with the construction and operation of these would also not occur. Implementation of this alternative would not accomplish the project objectives of improved water levels and circulation in the south Delta for local agricultural diversions, and improved hydrologic conditions that allow for increased diversion into Clifton Court Forebay to maximize the frequency of full pumping capacity. In addition, under this alternative the beneficial affects of the ISDP would not be achieved.

IV. SPECIAL-STATUS PLANTS

Introduction

Seven special-status plant species were located in the ISDP area during 1993 field surveys: Suisun Marsh aster, northern California black walnut, Delta tule pea, Mason's lilaeopsis, brittlescale, rose-mallow, and Delta mudwort. The first five species listed are federal Category 2 candidates; rose-mallow was recently reclassified as a Category 3b candidate; and Delta mudwort has no federal or state status, but is included on the California Native Plant Society's (CNPS) List 2: Plants Rare, Threatened, or Endangered in California, but more Common Elsewhere. Of the seven plants, only Mason's lilaeopsis is designated by DFG as rare; the others have no state status.

This chapter provides detailed information on the occurrence of these seven plants in the ISDP area and evaluates potential impacts of the Proposed Project and the eight alternatives being considered. Table IV-1 lists 47 other special-status plants that were considered for the Biological Assessment but were not found in the ISDP area during 1993 field surveys. The distributions and habitats of these plants are summarized from the Phase I Report -- Sensitive Species prepared for the Interim South Delta Project (MGA 1993). This Phase I Report contains detailed descriptions on the status, distribution, habitat requirements, and reasons for decline of 54 special-status plant species that could occur in the ISDP area. Distribution maps compiling all known occurrences of each plant are included in the Phase I Report for each of the 54 plant species.

Survey Methodology

Botanical surveys were limited to the ISDP area as identified in Figure IV-1. The survey area was defined to include all areas that could sustain direct or related impacts from implementation of the Proposed Project or any of the eight alternatives. Direct impacts include the placement and maintenance of facilities, channel dredging and the placement of dredge spoils, channel enlargement, and inundation of plant populations as a result of higher water levels in river channels due to barrier placement. Additional justification for the establishment of survey area boundaries is provided in MGA (1993).

None of the special-status plants discussed in this report occur along the Feather River channel, with the exception of hybrid northern California black walnut; therefore, changes in operations at Oroville Reservoir, and the resulting changes in water levels in the lower Feather River, would not impact any special-status plant species.

Field surveys for special-status plants were conducted on March 14 and 15, April 21, June 2, August 5, 6, and 31, and September 1, 2, 8, 9, 10, 14 and 15, 1993. The early spring surveys were targeted for upland species potentially occurring on Byron Tract, around Clifton Court Forebay, and levee banks where setbacks or placement of dredge spoils may occur. The late summer surveys were conducted on the water of the main channels and sloughs using a small boat and by walking or driving inland irrigation and drainage ditches and levee banks. All plants encountered during field surveys were identified to the extent necessary to determine their status as rare or endangered species.

Table IV-1. Special-Status Plants That Were Considered in the Biological Assessment But Do Not Occur In The ISDP Area

COMMON NAME (*Scientific Name*)	STATUS* Federal/State/CNPS	DISTRIBUTION	HABITAT	REASON PLANTS NOT FOUND
Adobe lily (*Fritillaria pluriflora* Torr. in Benth.)	C2/--/1B	Solano County north of the Delta region	heavy clay soils	No suitable habitat present Out of range of the ISDP area
Ahart's dwarf rush (*Juncus leiospermus* F.S. Herm. var. *ahartii* Ertter)	C1/--/1B	eastern edge of Sacramento Valley	borders of vernal pols	No suitable habitat present Out of range of the ISDP area
Ahart's whitlow-wort (*Paronychia ahartii* Ertter)	C2/--/1B	northern Sacramento Valley	annual grassland	No suitable habitat present Out of range of the ISDP area
Antioch Dunes evening-primrose (*Oenothera deltoides* Torr. & Frem. ssp. *howellii* [Munz]W.Klein)	E/E/1B	Antioch Dunes, Brannan Island	stabilized interior dunes	No suitable habitat present
Beach layia (*Layia carnosa* [Nutt.] T. & G.)	E/E/1B	coastal zone from Mendocino to Santa Barbara County	dunes and dune scrub	No suitable habitat present Out of range of the ISDP area
Bearded allocarya (*Plagiobothrys hystriculus* [Piper] Jtn.)	C3a/--/1A	Montezuma Hills, Solano County	vernal pools	No suitable habitat present Out of range of the ISDP area
Bogg's Lake hedge-hyssop (*Gratiola heterosepala* Mason & Bacig.)	C3c/E/1B	Great Valley from Fresno County north, North Coast Ranges	vernal pools and lakes	No suitable habitat present
Brewer's dwarf-flax (*Hesperolinon breweri* [Gray] Small)	C2/--/1B	inner Coast Range above 750 feet	chaparral, grassland	No suitable habitat present Out of range of the ISDP area
Butte County meadowfoam (*Limnanthes floccosa* T.J. Howell ssp. *californica* Arroyo)	E/E/1B	Butte and Tehama counties	seasonal wetlands	No suitable habitat present Out of range of the ISDP area

COMMON NAME (*Scientific Name*)	STATUS* Federal/State/CNPS	DISTRIBUTION	HABITAT	REASON PLANTS NOT FOUND
Caper-fruited tropidocarpum (*Tropidocarpum capparideum* Greene)	C2*/--/1A	base of Mt. Diablo in Contra Costa, Alameda, and San Joaquin counties; also Bay area and Glenn County	alkaline grassland	Surveyed for, but not found
Colusa grass (*Neostapfia colusana* [Davy] Davy)	T/E/1B	eastern edge of the San Joaquin Valley and Solano and Yolo counties north of the Delta	playa lakes and vernal pools	No suitable habitat present Out of range of the ISDP area
Contra Costa buckwheat (*Eriogonum truncatum* T. and G.)	C3a/--/1A	Mount Diablo area	oak woodland or coastal sage scrub	No suitable habitat present Out of range of the ISDP area
Contra Costa goldfields (*Lasthenia conjugens* Greene)	C1/--/1B	Delta region and coastal California to Santa Barbara	seasonal wetlands and vernal pools	No suitable habitat present
Contra Costa wallflower (*Erysimum capitatum* [Dougl.] Greene var. *angustatum* [Greene] G. Ross B.)	E/E/1B	Antioch Dunes	stabilized interior dunes	No suitable habitat present Out of range of the ISDP area
Delta button celery (*Eryngium racemosum* Jeps.)	C2/E/1B	Lower San Joaquin River Basin	seasonally ponded clay flats	Surveyed for, but not found
Diablo rock-rose (*Helianthella castanea* Greene)	C2/--/1B	Mt. Diablo area above 700 feet	chaparral, woodland,	No suitable habitat present Out of range of the ISDP area
Diamond-petaled California poppy (*Eschscholzia rhombipetala* Greene)	C2/--/1A	inner South Coast Range and Colusa County	grassland, clay slopes	No suitable habitat present Out of range of the ISDP area

COMMON NAME (*Scientific Name*)	STATUS* Federal/State/CNPS	DISTRIBUTION	HABITAT	REASON PLANTS NOT FOUND
Dudley's lousewort (*Pedicularis dudleyi* Elmer)	C2/R/1B	coastal zone, San Mateo to San Luis Obispo County	old growth coast redwood or Douglas-fir forest; maritime chaparral	No suitable habitat present Out of range of the ISDP area
Fragrant fritillary (*Fritillaria liliacea* Lindl.)	C2/--/1B	Coast Ranges from Sonoma to Monterey County	grassland or chaparral	No suitable habitat present Out of range of the ISDP area
Gairdner's yampah (also known as squaw root) (*Perideridia gairdneri* [Hook & Arn.] Mathias ssp. *gairdneri*)	C2/--/4	Coast Ranges from Napa to Monterey, and southern California	wetlands in broadleaved forest or chaparral	No suitable habitat present Out of range of the ISDP area
Greene's tuctoria (*Tuctoria greenei* [Vasey] J. Reeder)	PE/R/1B	eastern Great Valley from Tehama to Tulare County	vernal pools	No suitable habitat present Out of range of the ISDP area
Hairless popcornflower (*Plagiobothrys glaber* [Gray] Johnston)	C3a/--/1A	Alameda, Santa Clara, and San Benito counties	wet alkaline soils	Out of range of the ISDP area
Hartweg's pseudobahia (*Pseudobahia bahiifolia* [Benth.] Rydb.)	PE/E/1B	eastern Great Valley	annual grassland	Out of range of the ISDP area
Heartleaf saltbush (*Atriplex cordulata* Jeps.)	C2/--/1B	Basinlands of the lower San Joaquin River and Glenn County	alkaline grassland	Surveyed for, but not found
Hispid bird's-beak (*Cordylanthus mollis* Gray ssp. *hispidus* [Penn.] Chuang & Heckard)	C2/--/1B	Lower San Joaquin Valley and Placer County	saltgrass; seasonal wetlands	Surveyed for, but not found

COMMON NAME (*Scientific Name*)	STATUS* Federal/State/CNPS	DISTRIBUTION	HABITAT	REASON PLANTS NOT FOUND
Hoover's button celery (*Eryngium aristulatum* Jeps. var. *hooveri* Sheikh)	C1/--/4	South San Francisco Bay area to San Luis Obispo County	alkaline depressions	Surveyed for, but not found
Large-flowered fiddleneck (*Amsinckia grandiflora* [Gray] Kleeb. ex Greene)	E/E/1B	Mt. Diablo area	foothill woodland	No suitable habitat present Out of range of the ISDP area
Legenere (*Legenere limosa* [Greene] McVaugh)	C2/--/1B	lower Sacramento and San Joaquin valleys	vernal pools and seasonal wetlands	No suitable habitat present Out of range of the ISDP area
Marin knotweed (*Polygonum marinense* T. Mert and Raven)	C2/--/3	Marin and Napa counties	upper salt marsh	No suitable habitat present Out of range of the ISDP area
Marsh sandwort (*Arenaria paludicola* Rob.)	E/E/1B	San Francisco to San Bernardino County	coastal zone wetlands	No suitable habitat present Out of range of the ISDP area
Palmate-bracted bird's-beak (*Cordylanthus palmatus* [Ferris] Macbr.)	E/E/1B	Fresno to Colusa County	alkaline grassland and seasonal wetlands	Surveyed for, but not found
Point Reyes bird's-beak (*Cordylanthus maritimus* Nutt. ssp. *palustris* [Behr] Chuang & Heckard)	C2/--/1B	San Francisco Bay and north along the coast	coastal salt marsh	No suitable habitat present Out of range of the ISDP area
Recurved larkspur (*Delphinium recurvatum* Greene)	C2/--/1B	Colusa to Kings County	alkaline grassland	Surveyed for, but not found
Sacramento orcutt grass (*Orcuttia viscida* [Hoover] J. Reeder)	PE/E/1B	eastern Sacramento County	vernal pools	No suitable habitat present Out of range of the ISDP area

COMMON NAME (*Scientific Name*)	STATUS* Federal/State/CNPS	DISTRIBUTION	HABITAT	REASON PLANTS NOT FOUND
Sacramento Valley milk-vetch (*Astragalus tener* A. Gray var. *ferrisiae* Liston)	C2/--/1B	basinlands of the Sacramento Valley	alkaline meadows and grassland	Surveyed for, but not found
San Francisco gumplant (*Grindelia maritima* [Greene] Steyermark)	C2/--/1B	central California coast from Marin to San Luis Obispo	grassy slopes and north coast scrub	No suitable habitat present Out of range of the ISDP area
San Joaquin spearscale (*Atriplex joaquiniana* Nelson)	C2/--/1B	San Benito to Delta region and basinlands of the Sacramento Valley	alkaline grassland and meadows	Surveyed for, but not found
Showy Indian clover (*Trifolium amoenum* Greene)	C2*/--/1B	Coast Ranges from Mendocino to Alameda County	grasslands	No suitable habitat present
Slender orcutt grass (*Orcuttia tenuis* Hitchc.)	PT/E/1B	northern Sacramento Valley, and Sacramento and Lake counties	vernal pools	No suitable habitat present Out of range of the ISDP area
Slough thistle (*Cirsium crassicaule* [Greene] Jeps.)	C2/--/1B	San Joaquin River basin-lands	seasonal marsh, alkaline swales	Surveyed for, but not found
Soft bird's-beak (*Cordylanthus mollis* Gray ssp. *mollis*)	C1/R/1B	eastern San Francisco Bay, Suisun Marsh, Napa and Petaluma Rivers	salt marshes	No suitable habitat present Out of range of the ISDP area

COMMON NAME (*Scientific Name*)	STATUS* Federal/State/CNPS	DISTRIBUTION	HABITAT	REASON PLANTS NOT FOUND
Solano grass (*Tuctoria mucronata* [Crampton] Reeder)	E/E/1B	Solano and Yolo counties	playa lakes and vernal pools	No suitable habitat present Out of range of the ISDP area
Sonoma alopecurus (*Alopecurus aequalis* Sobol. var. *sonomensis* Rubtzoff)	C2/--/1B	Sonoma and Marin counties	freshwater and seasonal marsh, riparian	Out of range of the ISDP area
Suisun thistle (*Cirsium hydrophilum* [Greene] Jeps. var. *hydrophilum*)	C1/--/1B	Suisun marshes	freshwater marsh	Out of range of the ISDP area
Valley sagittaria (*Sagittaria sanfordii* Greene)	C2/--/1B	coastal southern California, San Joaquin and Sacramento valleys	sloughs, freshwater marsh	Surveyed for, but not found
Veiny monardella (*Monardella douglasii* Benth ssp. *venosa* [Torr.] Jeps)	C2/--/1B	eastern edge of the Great Valley	clay soils	No suitable habitat present Out of range of the ISDP area
Wedge-leaved horkelia (*Horkelia cuneata* Lindl. ssp. *sericea* [Gray] Keck)	C2/--/1B	coastal zone Sonoma to Santa Barbara counties	closed cone pine, coastal scrub	No suitable habitat present Out of range of the ISDP area

* Status Explanations:

Federal

E = Listed as endangered under the federal Endangered Species Act.

T = Listed as threatened under the federal Endangered Species Act.

PE = Proposed as endangered.

PT = Proposed as threatened.

C1 = Category 1 candidate for federal listing. Category 1 includes species for which the USFWS has sufficient biological information to support a proposal to list as endangered or threatened.

C2 = Category 2 candidate for federal listing. Category 2 includes species for which the USFWS has some biological information indicating that listing may be appropriate but for which further biological research and field study are usually needed to clarify the most appropriate status. Category 2 species are not necessarily less rare, threatened, or endangered than Category 1 species or listed species; the distinction relates to the amount of data available and is therefore administrative, not biological.

C2* = Category 2 candidate for federal listing,but plant is presumed to be extinct.

C3c = No longer a candidate for federal listing. Category 3c species have been dropped from the candidate list because they are too widespread or not threatened at this time.

State

-- = No designation.

E = Listed as endangered under the California Endangered Species Act.

R = Listed as rare under the California Endangered Species Act. This category is no longer used for newly listed plants, but some plants previously listed as rare retain this designation.

California Native Plant Society

1A = List 1A species: presumed extinct in California.

1B = List 1B species: rare, threatened, or endangered in California and elsewhere.

3 = List 3 species: plants about which more information is needed to determine their status.

4 = List 4 species: plants of limited distribution.

C—052417

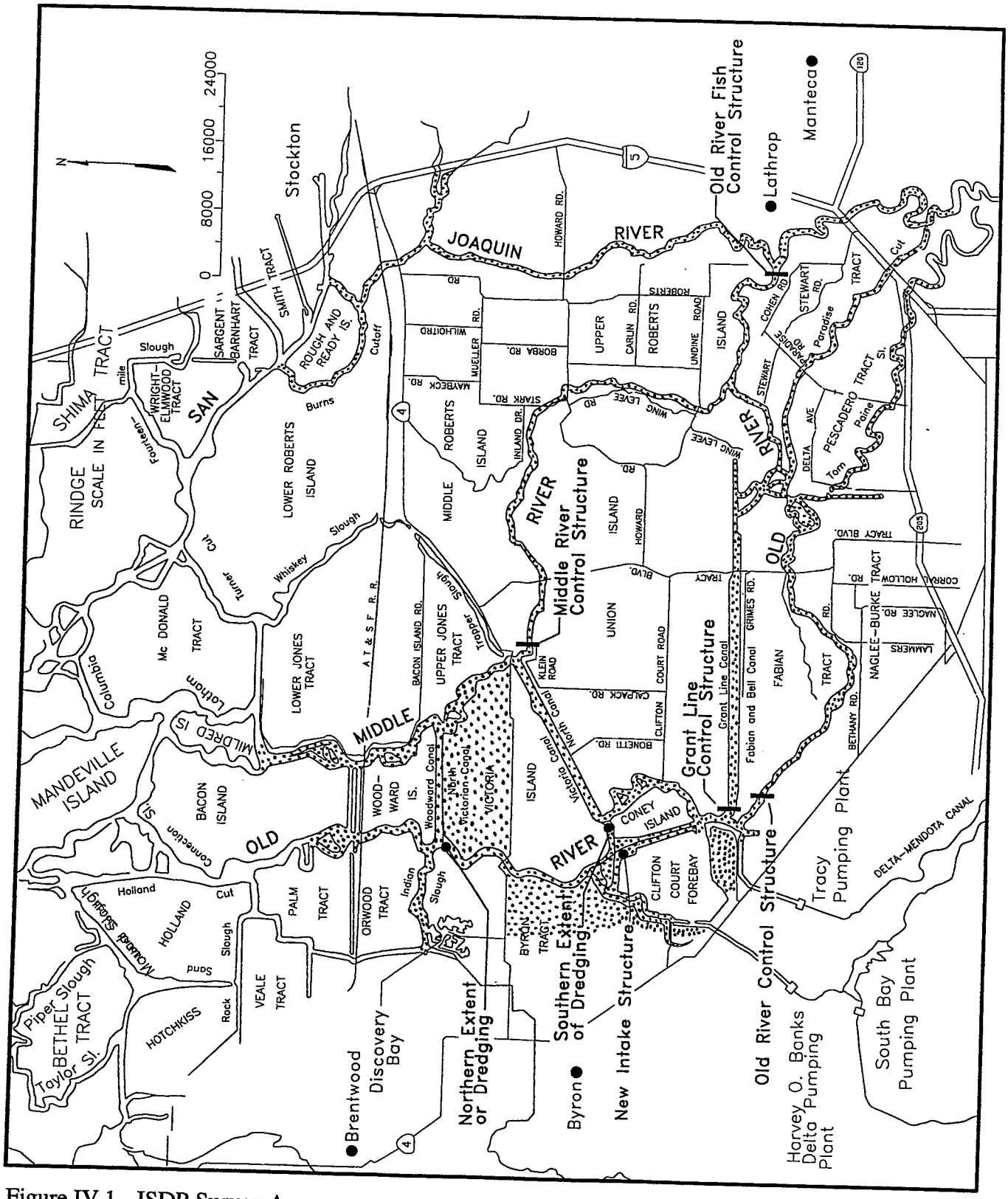

Figure IV-1. ISDP Survey Area

Population sizes of special-status plants were estimated by areal extent (Mason's lilaeopsis, Delta tule pea) or actual plant count (rose-mallow, Suisun Marsh aster, northern California black walnut). Table IV-2 summarizes the locations of special-status plants in the ISDP area by waterway. ISDP area waterways are separated into 10 sections and identified by the letters A through J; these correspond to mapped areas on Figure IV-2. Plants are discussed either as isolated occurrences or by island, depending on the continuity of the species' distribution.

Results

Tables IV-3 through IV-8 provide detailed locations and descriptions of special-status plant populations documented during the 1993 field surveys. A discussion of these populations and how they may be impacted by ISDP actions is provided in the following species accounts.

Suisun Marsh Aster

Status

Suisun Marsh aster (*Aster lentus* Greene) is a Category 2 candidate species for federal listing. The plant has no state status. CNPS includes it on List 1B: Plants Rare, Threatened, or Endangered in California and Elsewhere.

Distribution

Suisun Marsh aster is known from several locations in the western Sacramento/San Joaquin River Delta and Suisun Bay (CNPS 1994, NDDB 1992).

Habitat Requirements

Suisun Marsh aster grows in brackish and freshwater marshes. It occurs along brackish sloughs, riverbanks, and levees affected by tidal fluctuations. Associated species include marsh plants such as bulrush, cattail, common reed, willow, and rose-mallow. The plants are often found at, or near, the water's edge. One documented habitat occupied by Suisun Marsh aster in the Delta is inside the Delta levees along irrigation and drainage ditches (NDDB 1992).

Critical Habitat

No critical habitat has been designated for Suisun Marsh aster.

Reasons for Decline

Factors leading to the endangerment and decline of this species include the filling or draining of wetland habitats within the plant's range, pollution (oil spills, sewage discharges), and changes in water chemistry from water projects affecting Delta or Bay salinities (Niehaus 1977a). Levee maintenance, erosion, and fishing access in high traffic areas are also cited as threats (NDDB 1992).

Table IV-2. Summary of Special-Status Plant Locations in ISDP Area Waterways

Waterway	Suisun Marsh Aster	Rose-Mallow	Northern California Black Walnut	Delta Tule Pea	Mason's Lilaeopsis
A. Lower Middle River					
# sites	1	25	0	3	17
# plants/area ft^2	1	450	0	34	6,660
% total sites	33	50	0	100	22
% total plants/% total area ft^2	33	69	0	100	29
B. Upper Middle River					
# sites	0	2	0	0	0
# plants/area ft^2	0	3	0	0	0
% total sites	0	4	0	0	0
% total plants/% total area ft^2	0	<1	0	0	0
C. Lower Old River					
# sites	2	6	0	0	17
# plants/area ft^2	2	137	0	0	4,349
% total sites	66	12	0	0	22
% total plants/% total area ft^2	66	21	0	0	19
D. Old River at Clifton Court Forebay					
# sites	0	7	0	0	20

Waterway	Suisun Marsh Aster	Rose-Mallow	Northern California Black Walnut	Delta Tule Pea	Mason's Lilaeopsis
# plants/area ft^2	0	11	0	0	4,560
% total sites	0	14	0	0	26
% total plants/% total area ft^2	0	2	0	0	20
E. Upper Old River					
# sites	0	0	2	0	5
# plants/area ft^2	0	0	>25	0	1,490
% total sites	0	0	66	0	6
% total plants/% total area ft^2	0	0	>90	0	6
F. Grant Line-Fabian and Bell Canals					
# sites	0	1	1	0	4
# plants/area ft^2	0	5	1	0	27
% total sites	0	2	33	0	5
% total plants/% total area ft^2	0	1	1	0	<1
G. Victoria and North Canals					
# sites	0	5	0	0	4
# plants/area ft^2	0	10	0	0	1,470
% total sites	0	1	0	0	5
% total plants/% total area ft^2	0	2	0	0	6

C—052420

Waterway	Suisun Marsh Aster	Rose-Mallow	Northern California Black Walnut	Delta Tule Pea	Mason's Lilaeopsis
H. Woodward and North Victoria Canals					
# sites	0	2	0	0	2
# plants/area ft^2	0	6	0	0	500
% total sites	0	4	0	0	3
% total plants/% total area ft^2	0	1	0	0	2
I. Indian Slough					
# sites	0	2	0	0	5
# plants/area ft^2	0	32	0	0	3,710
% total sites	0	4	0	0	6
% total plants/% total area ft^2	0	5	0	0	16
J. San Joaquin River					
# sites	0	0	0	0	4
# plants/area ft^2	0	0	0	0	37
% total sites	0	0	0	0	5
% total plants/% total area ft^2	0	0	0	0	<1

sites = Number of sites or populations where the taxa is found in each waterway.
plants/area ft^2 = Number of plants or areal coverage of all the populations within a waterway.
% total sites = Percentage of all sites or populations in the ISDP area found in each waterway.
% total plants/% total area ft^2 = Percentage of the total number of individuals or total coverage of a taxa in the ISDP area found in each waterway. (Numbers for Suisun Marsh aster, rose-mallow, and northern California black walnut represent individual plants. Numbers for Delta tule pea and Mason's lilaeopsis represent the approximate square footage occupied by these plant populations.)

C—052421

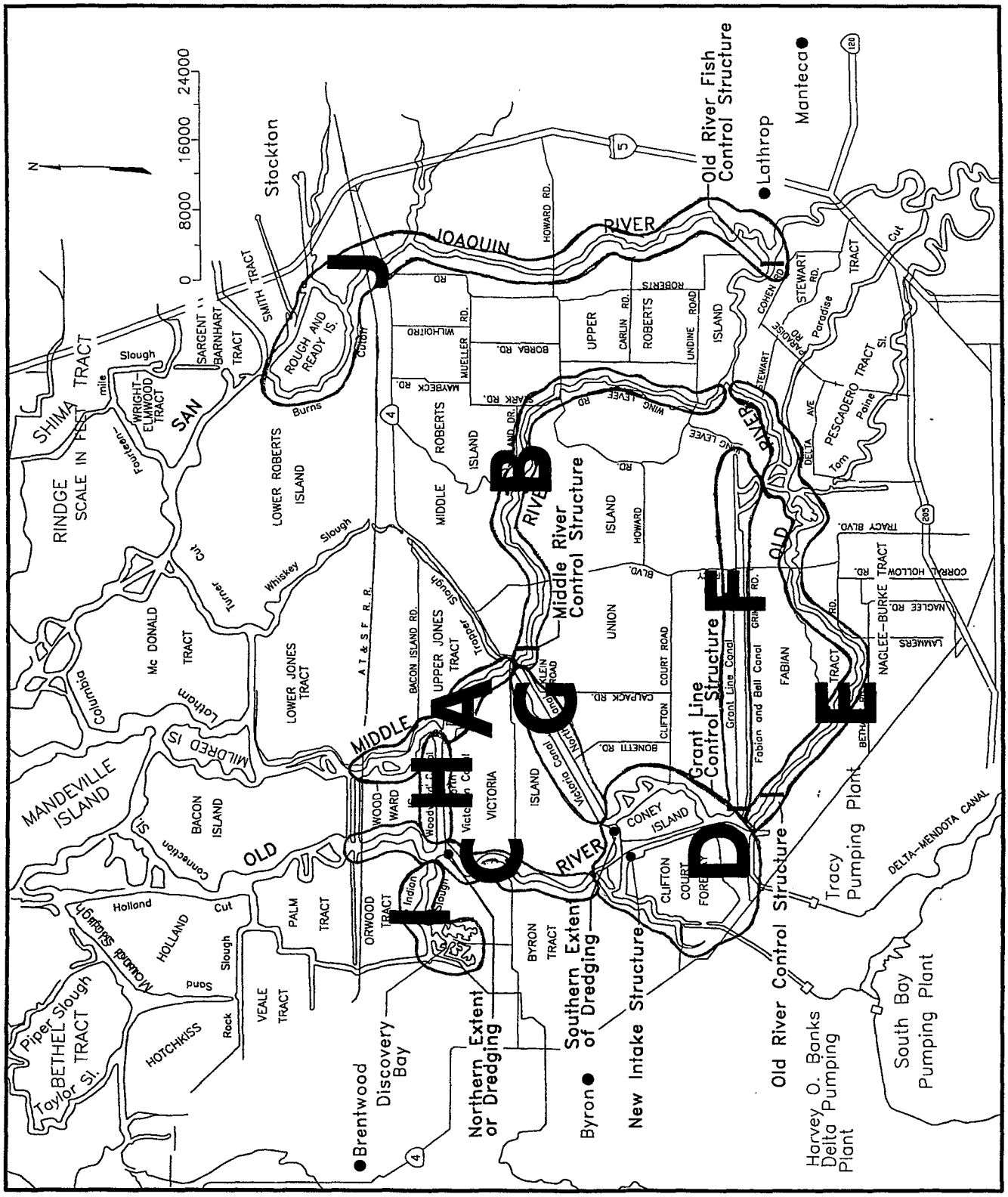

Figure IV-2. Waterways in the ISDP Area

C-052422

Occurrence in the ISDP Area

Within the ISDP survey area, three new locations for Suisun Marsh aster were mapped during 1993 field surveys (see Table IV-3). All three locations are in the northern end of the ISDP area and are an extension of the known population on the western shore of Bacon Island, approximately 4 miles north of Victoria Island (Jones & Stokes Associates 1990a). Two plants were observed near the Mokelumne Aqueduct crossing on the lower Old River and one plant was observed at the aqueduct crossing on the lower Middle River.

Impacts of the Proposed Project

No impacts to Suisun Marsh aster are expected as a result of the Proposed Project. Plants are not located in areas where facilities would be constructed or where dredging would occur. Small changes in water levels (-0.1 foot to +0.1 foot) that may occur in the northern portions of the channels flanking Woodward Island are not expected to affect Suisun Marsh asters.

Mitigation Measures

None required.

Impacts of Alternatives

None of the alternatives being considered would impact Suisun Marsh aster.

Mitigation Measures

None required.

Northern California Black Walnut

Status

Northern California black walnut (*Juglans californica* Wats. var. *hindsii* Jeps.) is classified as a Category 2 candidate species for federal listing. It has no state status. CNPS includes northern California black walnut on List 1B: Plants Rare, Threatened, or Endangered in California and Elsewhere.

Distribution

The original distribution of northern California black walnut is unknown. Stands along Walnut and Lafayette creeks in Contra Costa County, near Walnut Grove in Sacramento County, and near Wooden Valley in Napa County are cited as the "native" stands of this species and are considered endangered (CNPS 1994, NDDB 1992). The species was planted as street trees in central California and used as root stock for the early California walnut industry. It freely hybridizes with commercial varieties (Munz and Keck 1968). California black walnut and various crosses have since become

Table IV-3. Locations of Suisun Marsh Aster (*Aster lentus*) in the ISDP Area

QUADRANGLE (USGS 7½')	WATERWAY	LOCATION/DESCRIPTION	NUMBER OF PLANTS
Woodward Island	Old River	On the outer levee bank of Upper Jones Tract on riprap (disturbance) surrounding the Mokelumne Aqueduct crossing	1
Woodward Island	Old River	On a piling adjacent to the Woodward Island levee approximately 1,500 feet SE of the Mokelumne Aqueduct crossing	1
Woodward Island	Middle River	On a piling adjacent to the Upper Jones Tract levee at the Mokelumne Aqueduct crossing	1

widely naturalized in riparian forests of the Great Valley and surrounding foothills (CNPS 1994, Griffin and Critchfield 1972, NDDB 1992). Many sites are associated with Indian settlements, undoubtedly brought there by the residents (Munz and Keck 1968).

Habitat Requirements

Northern California black walnut is associated with deep alluvial soil near creeks, streams, or springs that provide summer water. It is a riparian canopy tree, often associated with Valley oak, Oregon ash, and poison oak (CNPS 1994).

Critical Habitat

No critical habitat has been designated for this species.

Reasons for Decline

Only two of the original "native" stands of northern California black walnut still survive as pure genetic stock (CNPS 1994). The species is threatened by hybridization with English walnut and the black walnut of the eastern United States, both of which were widely used in the early walnut industry.

Occurrence in the ISDP Area

Three locations of northern California black walnut were found in the ISDP area. The genetic makeup of these trees was not determined as a part of our study, nor was a survey of prehistoric sites confirmed in this vicinity that might suggest the presence of "native" black walnut. In the absence of appropriate genetic data, we can only speculate that these trees are hybrids and are not of significance other than as components of the riparian forest. Two stands are located in the upstream reaches of the Old River and one is located on Salmon Slough in the eastern portion of the ISDP area (see Table IV-4). All of the sites are found in association with current or historic Valley oak woodlands. "Native" or "genetically pure" black walnut could have been a part of the original riverine forest of these areas; however, all of the plants are growing on levee banks that clearly are not historic in origin.

Impacts of the Proposed Project

It is improbable that genetically pure northern California black walnut is present in the south Delta. The channels of Old River and Salmon Slough where two of the hybrid black walnut sites are located would be subjected to higher minimum water elevations as a result of flow control structures in downstream reaches. Since these trees are rooted on the levee, however, the unsaturated volume of soil available to them should be adequate to support growth and maintain the health of the trees. Higher water levels would not prevent new walnut trees from establishing on the levees.

No direct impacts due to facility construction would occur.

Mitigation Measures

None required.

Table IV-4. Locations of Northern California Black Walnut (*Juglans californica* var. *hindsii*) in the ISDP Area

QUADRANGLE (USGS 7½')	WATERWAY	LOCATION/DESCRIPTION	NUMBER OF PLANTS
Union Island	Salmon Slough	On east bank of slough approximately 1,300 feet south of confluence with Grant Line/Fabian and Bell Canal	1
Union Island	Old River	On north bank of river approximately 1,500 feet NE of junction of San Jose and Bethany roads; many trees over about 900 feet of bank	many
Union Island	Old River	On SE bank of river approximately 2,300 feet N of junction of Bethany and Lammers roads	1

Impacts of Alternatives

No impacts to California black walnut are expected from any alternatives being considered.

Mitigation Measures

None required.

Delta Tule Pea

Status

Delta tule pea (*Lathyrus jepsonii* Greene ssp. *jepsonii*) is classified as a Category 2 candidate for federal listing. It has no state status. CNPS includes Delta tule pea on List 1B: Plants Rare, Threatened, or Endangered in California and Elsewhere.

Distribution

Delta tule pea occurs on the Delta islands of the lower Sacramento and San Joaquin rivers and westward through Suisun Bay to the lower Napa River. The plant also has been reported in western Alameda and Santa Clara counties, as well as from the mountains of San Benito and Fresno counties (CNPS 1994, NDDB 1992).

Habitat Requirements

Delta tule pea is a sprawling perennial vine found in coastal and Valley freshwater marsh. It has been observed in association with a broad spectrum of other plants ranging from common tule to Valley oak to arrowgrass. It prefers sites above tidal influence, but still within the area of soil saturation (NDDB 1992).

Critical Habitat

No critical habitat has been designated for this species.

Reasons for Decline

Agricultural conversion, water diversions, vegetation burning, dredge spoil disposal, recreation, changes in salinity, and levee construction and maintenance all are cited as reasons for the species decline (CNPS 1994, Niehaus 1977b).

Occurrence in the ISDP Area

All of the known locations of Delta tule pea are within the ISDP area. Four populations of the plant were found in the lower reaches of the Middle River by the same botanist during 1988 field surveys of the south Delta region (ECOS 1990a). An additional individual plant was recorded

during field surveys for the temporary barriers project on Grant Line Canal (DWR 1992). During the 1993 field season, three populations of Delta tule pea were relocated, all of which occur on islands in the lower reach of the Middle River (see Table IV-5).

Impacts of the Proposed Project

No direct impacts are anticipated for Delta tule pea populations. Water level changes which may result from ISDP actions are not expected to significantly affect the lower Middle River.

Monitoring data for Delta tule pea populations in the temporary barriers project were inconclusive since the plant was lost to other direct causes before the effects of higher water levels could be determined (DWR 1994). The wide breadth of habitat utilized by Delta tule pea (DWR 1994, McCarten and Ornduff 1990, Grewell pers. comm.) suggests that plants located above the permanent barrier on Fabian and Bell canals would survive the small increases in minimum water levels predicted by the barriers operation. The change in water levels would not affect the extent of habitat available for the natural colonization and establishment of new Delta tule pea populations.

Impact Potential loss of Delta tule pea would occur if erosion of the island across from the proposed northern intake to Clifton Court Forebay is accelerated by higher flows in West Canal and Middle River.

Mitigation Measure Protection of this island from wave-wash by floating booms or other barricades would reduce the erosion.

Impacts of Alternatives

1. *Enlargement of Clifton Court Forebay, Construction of Two Intake Structures, Increased Export Capability, and Construction of Permanent Barriers*

Impact Construction of an intake structure at the confluence of North Victoria Canal and Middle River and widening of this section of Middle River would result in the loss of channel island habitat in these waterways. Two populations of Delta tule pea are present on islands immediately north of the confluence. Local changes in velocity and water level would occur during operation of the intake which would accelerate the loss of this habitat.

Mitigation Measure The protection of island habitats with erosion control barriers and the creation of new channel islands as part of the widening of Middle River would mitigate impacts to Delta tule pea. The loss of habitat associated with the widening of Middle River could be mitigated by construction of a parallel channel which leaves existing levees as instream islands. The new islands would be managed for natural values including habitat for sensitive plants.

2. *Reduction of CVP/SWP Exports and Management Reduction of Demand for SWP Water*

No impacts to Delta tule pea are anticipated as a result of this alternative.

Table IV-5. Locations of Delta Tule Pea (*Lathyrus jepsonii* ssp. *jepsonii*) in the ISDP Area

QUADRANGLE (USGS 7½')	WATERWAY	LOCATION/DESCRIPTION	SQUARE FOOTAGE
Woodward Island	Middle River	On northeastern tip of long narrow island approximately 800 feet east of the eastern tip of Woodward Island	12 ft^2
Woodward Island	Middle River	On the western side of island located approximately 2,500 feet SE of the NE tip of Victoria Island; plants are located approximately 400 feet from the NW corner of the island	12 ft^2
Woodward Island	Middle River	On the western side of large irregular-shaped island located under powerlines crossing from Upper Jones Tract to Victoria Island; plants are located approximately 1,500 feet SE of the island's northern tip	10 ft^2

3. *Increased Flows in the San Joaquin River, Modifications of CVP/SWP Exports, Channel Dredging for Agricultural Diversions, Extending and/or Consolidation of Diversions, Screening of Diversions, Improvements to the Skinner Fish Salvage Facility, and Predation Control*

Impact Potential adverse impacts could occur to Delta tule pea due to the placement of diversion facilities and channel dredging around known populations.

Mitigation Measure Avoidance of known Delta tule pea populations during the planning and construction of diversion facilities and channel dredging operations would prevent impacts to this plant.

4. *ISDP with an Additional Intake to Clifton Court Forebay at Italian Slough*

No additional impacts are expected as a result of this alternative

5. *ISDP without the Northern Intake and with an Expanded Existing Intake*

No additional impacts are expected as a result of this alternative. Accelerated erosion of the island across from the proposed northern intake could still occur as a result of high water volumes in West Canal.

Mitigation Measure Erosion control barriers such as floating booms or other barricades should be installed to protect the island at the north end of West Canal.

6. *ISDP without the Northern Intake and with an Intake at Italian Slough*

No additional impacts to Delta tule pea are expected.

7. *No Action (maintain existing conditions)*

Continued loss of Delta tule pea populations would occur through the loss of island habitat, levee bank and vegetation clearing, and other endangering factors.

8. *No Action (maintain conditions as they would exist in the future)*

Continued loss of Delta tule pea populations would occur through the loss of island habitat, levee bank and vegetation clearing, and other endangering factors.

Rose-Mallow

Status

Rose-mallow (*Hibiscus lasiocarpus* Cav.), formerly known as California hibiscus, is classified as a Category 3b species which reflects the recent nomenclature change of this taxon from *H. californicus* which was previously considered to be restricted to California. The plant has no state status. CNPS

includes rose-mallow on List 2: Plants Rare, Threatened, or Endangered in California, but more Common Elsewhere (CNPS 1994).

Distribution

Rose-mallow occurs along the Sacramento River and adjoining sloughs from Butte County to the Delta. Outside of California, the species is widespread, but threatened, in western North America and occurs as far east as Missouri (NDDB 1992, CNPS 1994).

Habitat Requirements

In California, rose-mallow is restricted to freshwater marshes in riverine backwaters, irrigation canal banks, and Delta islands. It is associated with tules, willows, buttonwillow, and other marsh and riparian species on heavy silt, clay, or peat soils (NDDB 1992).

Critical Habitat

No critical habitat has been designated for this species.

Reasons for Decline

Within California, the loss of riverine wetlands, sloughs, and other freshwater marsh habitats through channelization of the Sacramento River and its tributaries is the leading cause of the plant's decline (CNPS 1994). In the south Delta, levee maintenance, bank erosion, and island submergence have resulted in the loss of some populations of rose-mallow (NDDB 1992).

Occurrence in the ISDP Area

Rose-mallow populations or individual plants were found in 18 locations during previous field surveys conducted by the same botanist in the south Delta region (ECOS 1990a). An additional three populations or individual plants were located in Grant Line Canal above the temporary barriers during surveys for the Temporary Barriers Project (DWR 1992). During 1993 field surveys, a total of 50 sites supporting rose-mallow were recorded (see Table IV-6). This represents an estimated total of 654 plants located in the ISDP area. Over two-thirds of the sites (38 out of 50) and 97 percent of the individuals were found growing on instream islands. Only 21 rose-mallow plants were observed growing on the outer banks of levees and none were observed in the island interiors. Four previously-reported rose-mallow populations (ECOS 1990a) were not relocated during 1993 surveys (see Table IV-7). Three out of these four sites were on levee banks and the fourth was on an island in the Middle River near Coney Island that was lost to erosion.

Within the ISDP study area, the largest known populations of rose-mallow occur in the lower reach of the Middle River. Fifty percent of the locations and nearly 70 percent of the individuals were mapped in this reach. A second concentration of rose-mallow plants, 12 percent of the sightings and 21 percent of the plants, is located in the lower reach of the Old River north of Clifton Court Forebay. Rose-mallow occurs sparingly in other waterways of the ISDP area with the exception of the upper reach of the Old River and the San Joaquin River and vicinity.

Table IV-6. Locations of Rose-Mallow (*Hibiscus lasiocarpus*) in the ISDP Area

QUADRANGLE (USGS 7½')	WATERWAY	LOCATION/DESCRIPTION	NUMBER OF PLANTS
Holt	Middle River	On island located approximately 3,300 feet NW of tide gauge at Highway 4 bridge (next column represents count for island)	6
Holt	Middle River	On northern tip of island located approximately 1,300 feet SE of tide gauge at Highway 4 bridge	1
Holt	Middle River	On western end of island approximately 400 feet SE of tide gauge at Highway 4 bridge	2
Holt	Middle River	On island located approximately 5,300 feet NE of Tracy Blvd. bridge	1
Holt	Victoria Canal	On north bank of island separating Victoria and North canals located approximately 2,400 feet W of the island's eastern tip	1
Holt	North Canal	On south bank of island separating Victoria and North canals located approximately 2,500 feet W of island's eastern tip	1
Woodward Island	Middle River	At the outer base of western levee of Upper Jones Tract approximately 20 feet SE of transmission tower on Bacon Road	1
Woodward Island	Middle River	On midstream island with transmission tower just south of Mokelumne Aqueduct crossing	10
Woodward Island	Middle River	Small island beneath powerline running between Upper Jones Tract and Woodward Island	8
Woodward Island	Middle River	At outer base of Woodward Island levee approximately 600 feet due S of transmission tower from line running between Woodward Island and Upper Jones Tract	3

QUADRANGLE (USGS 7½')	WATERWAY	LOCATION/DESCRIPTION	NUMBER OF PLANTS
Woodward Island	Middle River	At outer base of Upper Jones Tract levee approximately 900 feet SE of transmission tower off Bacon Road	1
Woodward Island	Middle River	On island located approximately 2,300 feet SE of Mokelumne Aqueduct crossing	12
Woodward Island	Middle River	On large island located approximately 2,600 feet S of Mokelumne Aqueduct crossing	78
Woodward Island	Middle River	At outer base of Upper Jones Tract levee approximately 4,000 feet SSE of Mokelumne Aqueduct crossing	1
Woodward Island	Middle River	On narrow oblong island located WNW of Woodward Island ferry crossing	10
Woodward Island	Middle River	On large irregular-shaped island WNW of Woodward Island ferry crossing	76
Woodward Island	Middle River	At outer base of Upper Jones Tract levee approximately 2,500 feet WNW of junction of Bacon Island Road and the levee; two groups of 2 plants each	4
Woodward Island	Middle River	On small island located approximately 2,700 feet WNW of Woodward Island ferry crossing	18
Woodward Island	Middle River	On small island located approximately 400 feet WNW of Woodward Island ferry crossing	5
Woodward Island	Middle River	On narrow island beginning approximately 200 feet SE of Woodward Island ferry crossing	65
Woodward Island	Middle River	On triangular-shaped island off the eastern tip of Woodward Island	5
Woodward Island	Middle River	On small narrow island trending NW approximately 200 feet SE of Woodward Island ferry crossing	5

QUADRANGLE (USGS 7½')	WATERWAY	LOCATION/DESCRIPTION	NUMBER OF PLANTS
Woodward Island	Middle River	On outer base of Upper Jones Tract levee located 900 feet across the channel from the eastern tip of Woodward Island	2
Woodward Island	Middle River	On large island located across from the mouth of Woodward and North Victoria canals	30
Woodward Island	Middle River	On the outer base of the Upper Jones Tract levee approximately 3,000 feet NW of transmission tower connecting Upper Jones Tract to Victoria Island	1
Woodward Island	Middle River	At the outer base of Victoria Island levee approximately 1,400 feet SE of the island's NE tip	1
Woodward Island	Middle River	On a triangular-shaped island located approximately 1,800 feet SE of the confluence of Middle River with Woodward and North Victoria canals	9
Woodward Island	Middle River	On island located 2,500 feet SE of confluence of Middle River with Woodward and North Victoria canals	38
Woodward Island	Middle River	On large irregular-shaped island located under powerlines crossing from Upper Jones Tract to Victoria Island (count is estimate from reconstructed field notes)	60
Woodward Island	Woodward Canal	On outer base of Woodward Island levee approximately 1,700 feet from the island's SE tip	1
Woodward Island	Woodward and North Victoria Canals	On most easterly island separating Woodward and North Victoria canals	5
Woodward Island	Old River	On island approximately 3,000 feet S of AT&SF RR bridge	40
Woodward Island	Old River	On island approximately 4,800 feet S of AT&SF RR bridge	60

QUADRANGLE (USGS 7½')	WATERWAY	LOCATION/DESCRIPTION	NUMBER OF PLANTS
Woodward Island	Old River	On triangular island off the eastern tip of Orwood Tract	21
Woodward Island	Old River	At the outer base of the Orwood Tract levee at the island's eastern tip	1
Woodward Island	Old River	On the narrow rectangular island located approximately 2,000 feet NE of confluence of Old River and Indian Slough	12
Woodward Island	Old River	On the outer levee base of Victoria Island levee approximately 4,000 feet N of the gaging station on Old River at Highway 4	4
Woodward Island	Indian Slough	On tear-shaped island in St. Mary's Bay	12
Woodward Island	Indian Slough	On N-S trending island in St. Mary's Bay	20
Clifton Court	Italian Slough	On SW end of island directly N of the north end of Clifton Court levee	1
Clifton Court	Old River	On the east side of western "hook" of Eucalyptus Island	1
Clifton Court	Old River	On the north bank of Eucalyptus Island located approximately 350 feet east of the island's western "hook"	4
Clifton Court	Old River	On the north bank of Eucalyptus Island located approximately 800 feet east of the island's western "hook"	2
Clifton Court	Old River	On the east bank of the island located at the northern confluence of Old River and West Canal; plant is located approximately 500 feet N of the island's southern tip	1
Clifton Court	Old River	On the west bank of the island located at the northern confluence of Old River and West Canal, plant is located approximately 600 feet N of the island's southern tip	1

QUADRANGLE (USGS 7½')	WATERWAY	LOCATION/DESCRIPTION	NUMBER OF PLANTS
Clifton Court	Victoria Canal	On north side of island separating Victoria and North canals located approximately 400 feet from the island's west end	2
Clifton Court	North Canal	On south side of island separating Victoria and North canals located over a 2,500-foot length starting approximately 1,100 feet from the west end of the island chain	5
Clifton Court	Victoria Canal	On the outer base of Victoria Island levee approximately 3,400 feet NE of gaging station at confluence with Old River	1
Clifton Court	Old River	On island located immediately east of S tip of Coney Island	1
Clifton Court	Grant Line Canal	On north side of islands separating Grant Line and Fabian and Bell canals; located approximately 2,000 feet east of the western tip of the island. (Note: One plant was identified at this location in 1987 [ECOS 1987])	5

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Table IV-7. Populations of Rose-Mallow (*Hibiscus lasiocarpus*) Not Relocated in the ISDP Area

QUADRANGLE (USGS 7½')	WATERWAY	LOCATION/DESCRIPTION
Clifton Court	West Canal	two plants located in riprap at the outer base of the Coney Island levee approximately 500 feet south of the southern tip of the island located in the northern confluence of West Canal and Old River
Clifton Court	West Canal	one plant growing on a log with *Mason's lilaeopsis* at the outer base of the Coney Island levee approximately 2,500 feet south of the southern tip of the island located at the northern confluence of West Canal and Old River
Clifton Court	Old River	one plant on island located approximately 1,700 feet NE of Coney Island Bridge
Clifton Court	Grant Line Canal	one plant located at outer base of levee approximately 800 feet SE of gaging station on Old River

Note: The populations listed above were originally located by the same botanist in 1987 (ECOS 1987). These populations were not relocated during 1993 field surveys.

Impacts of the Proposed Project

Increases in minimum water elevations during the irrigation season behind permanent barriers would not cause harm to existing rose-mallow plants. Maximum water levels behind the barriers would not be significantly increased. Changes in water levels as a result of the operation of temporary water control barriers in the Middle River near Victoria Canal did not adversely affect rose-mallow (DWR 1994). An increase in *Iris psuedacorus* was noted upstream of the Middle River barrier on an island that was inundated by artificially high tides (DWR 1994). This introduced iris is thought to compete with rose-mallow and may respond to the same favorable conditions that enhanced rose-mallow growth above the barriers. The elevational range of these two species was not investigated as a part of the temporary barriers project (Grewell pers. comm). If these two species occupy similar ecological zones, the water level changes above the barriers may intensify the competition for limited habitat between these two species.

Higher minimum water levels would not prevent new populations of rose-mallow from establishing, or lessen the extent of suitable habitat available to the plants above the barriers.

Impact The proposed intake to Clifton Court Forebay on West Canal is located directly across from an instream island supporting two rose-mallow plants. It is possible that erosion of this island would be accelerated by increased flows in the area and that these two plants would be lost.

Mitigation Measure Protection of this island from wave-wash by floating booms or other barricades would reduce the erosion.

Impact The dredging of Old River from West Canal to Indian Slough could affect four rose-mallow plants growing at the base of the Victoria Island levee. Larger populations of rose-mallow downstream of Indian Slough, in the Eucalyptus Island area around Clifton Court Forebay, and in lower Middle River are not expected to be affected by ISDP actions. Water level or velocity changes are not anticipated to be significant in these areas.

Mitigation Measure Avoidance of the rose-mallow populations during dredging of Old River would eliminate potential impacts to the plants.

Impacts of Alternatives

1. *Enlargement of Clifton Court Forebay, Construction of Two Intake Structures, Increased Export Capability, and Construction of Permanent Barriers*

Impact Construction of an intake structure on Victoria Island at the confluence of North Victoria Canal and Middle River and widening of this section of Middle River would result in the loss of channel island habitat in these waterways. The islands of Middle River support large populations of rose-mallow. Several populations of rose-mallow consisting of approximately 105 plants are located in the immediate vicinity of the confluence. Local changes in velocity and water level would occur during operation of the intake and would accelerate the loss of this habitat.

Mitigation Measure Erosion control barriers on islands in the vicinity of the intake would mitigate losses within this freshwater marsh and scrub habitat. New island habitat should be created as a part of the channel widening in Middle River. The loss of habitat associated with the widening of Middle

River could be mitigated by construction of a parallel channel which leaves existing levees as instream islands. The new islands would be managed for natural values including habitat for sensitive plants.

2. *Reduction of CVP/SWP Exports and Management Reduction of Demand for SWP Water*

No impacts to rose-mallow are expected under this alternative. Small changes in water levels over time or during certain water years would not affect the survival or regeneration of this species.

3. *Increased Flows in the San Joaquin River, Modifications of CVP/SWP Exports, Channel Dredging for Agricultural Diversions, Extending and/or Consolidation of Diversions, Screening of Diversions, Improvements to the Skinner Fish Salvage Facility, and Predation Control*

Impact Potential adverse impacts could occur to rose-mallow due to the placement of diversion facilities and channel dredging around known populations.

Mitigation Measure Avoidance of known rose-mallow populations during the planning and construction of diversion facilities and channel dredging operations would prevent impacts to this species.

4. *ISDP with an Additional Intake to Clifton Court Forebay at Italian Slough*

Impact Increased flows through Italian Slough may cause scour and accelerate the loss of island habitats in this waterway. One population of rose-mallow is present in Italian Slough and several others are found in the vicinity of Widdows and Eucalyptus islands.

Mitigation Measure Islands in Italian Slough should be protected from wave wash by erosion control structures.

5. *ISDP without the Northern Intake and with an Expanded Existing Intake*

Impact Rose-mallow losses as described for the Proposed Project would also apply to this alternative. Increased flows in West Canal could accelerate erosion of the unnamed island at the northwest corner of Coney Island where two rose-mallow plants are found.

Mitigation Measure Measures as described for the Proposed Project would eliminate adverse impacts to rose-mallow populations.

6. *ISDP without the Northern Intake and with an Intake at Italian Slough*

Impact Impacts would be the same as those described for Alternative 4, but could be more extensive due to the greater volume of water moving through the channel.

Mitigation Measure Mitigation as described for Alternative 4 would also apply to this alternative. Construction of protective barriers may need to include portions of Eucalyptus Island.

7. *No Action (maintain existing conditions)*

Continued loss of rose-mallow populations is expected due to island erosion and other endangering factors.

8. *No Action (maintain conditions as they would exist in the future)*

Continued loss of rose-mallow populations is expected due to island erosion and other endangering factors.

Mason's Lilaeopsis

Status

Mason's lilaeopsis (*Lilaeopsis masonii* Math and Const.) is classified as a Category 2 candidate species for federal listing. It is listed as rare by DFG. CNPS includes Mason's lilaeopsis on List 1B: Plants Rare, Threatened, or Endangered in California and Elsewhere.

Distribution

Mason's lilaeopsis occurs at scattered localities throughout the Sacramento and San Joaquin River Delta and in sloughs and marshes westward to the lower Napa River (CNPS 1994, NDDB 1992). An historic location for Mason's lilaeopsis is recorded in Tomales Bay at Chicken Ranch Beach (Golden and Fiedler 1991).

Habitat Requirements

Mason's lilaeopsis is found in tidally-inundated freshwater and brackish water marshes. It grows on the banks of instream islands or along the bases of earthen levees where it forms a low turf with arrowgrass and marsh pennywort (Golden and Fiedler 1991, NDDB 1992).

Critical Habitat

No critical habitat has been designated for Mason's lilaeopsis.

Reasons for Decline

Flood control, levee construction and protection, bank erosion, salt water intrusion, and weed control (especially for water hyacinth) are known to have extirpated local populations of this species (DFG 1992, DWR 1993, Golden and Fiedler 1991, NDDB 1992). Mudbank erosion due to high winter flows and boat wake action during the rest of the year have resulted in net losses of monitored *Lilaeopsis* populations (DWR 1994).

Occurrence in the ISDP Area

With the exception of the historic location of Mason's lilaeopsis at Tomales Bay, the plant is known only from locations within the ISDP area. The species was found at 28 sites during prior surveys of the south Delta region in 1988 (ECOS 1990a). An additional 25 populations were identified during field surveys for the South Delta Temporary Barriers Project (DWR 1992). Some of these sites may be duplicate records of a single population. During 1993 field surveys, 78 distinct populations of Mason's lilaeopsis covering approximately 22,800 square feet (0.52 acre) were found (see Table IV-8).

Over the entire ISDP study area, Mason's lilaeopsis populations were most common and best developed on instream islands. Ninety percent of the square footage of the populations found occurred on islands and only 10 percent were found at the bases of levees. Five small populations totalling 11 square feet were observed on pilings, logs, or stumps. The average size of Mason's lilaeopsis patches on islands was 330 square feet, while only five of the 30 *Lilaeopsis* patches observed at the bases of levees exceeded 10 square feet in extent. One of these larger levee base populations is being monitored by DWR in the Old River (DWR 1993).

Mason's lilaeopsis occurs throughout the ISDP area; however, the largest concentrations of the plant are in the lower reach of the Middle River. There are 17 populations along this segment of river, all occurring on islands. These populations account for nearly one-third of the mapped area. The lower reach of the Old River north of Clifton Court Forebay also supports 17 populations, but only 19 percent of the total population area. Only four *Lilaeopsis* populations in this reach were greater than 60 square feet in extent. Another 20 percent of the mapped *Lilaeopsis* is found in the vicinity of Clifton Court Forebay, Coney Island, Eucalyptus Island, and the surrounding segment of the Old River. The other concentration of *Lilaeopsis*, 16 percent of the total mapped area, is within Indian Slough on islands north of Discovery Bay. Small populations of *Lilaeopsis* were found in all the other waterways of the ISDP area during 1993 with the exception of the upper reach of the Middle River, which was clogged with water hyacinth at the time of our surveys. Mason's lilaeopsis had the broadest distribution of the special-status plants encountered in the ISDP study area, and occurred the farthest upstream with locations in Sugar Cut, near Tom Paine Slough, and within Burns Cutoff off the San Joaquin River.

Impacts of the Proposed Project

Impact The northern intake to Clifton Court Forebay on West Canal could impact an island supporting a large population of Mason's lilaeopsis. As discussed previously for rose-mallow and Delta tule pea, the island would be subjected to increased flows in the area and this could accelerate its loss to erosion. Other Mason's lilaeopsis populations in the Clifton Court Forebay area around Eucalyptus and Widdows islands are not expected to be affected by increased flows at the northern intake.

Mitigation Measure As discussed previously for rose-mallow, the construction of erosion control barriers around this island should mitigate the loss of Mason's lilaeopsis at that site.

Table IV-8. Locations of Mason's Lilaeopsis (*Lilaeopsis masonii*) in the ISDP Area

QUADRANGLE (USGS 7½ ')	WATERWAY	LOCATION/DESCRIPTION	SQUARE FOOTAGE
Stockton West	Burns Cutoff	Just west of Jacob's Bridge on south bank, on piling	1 ft^2
Stockton West	Burns Cutoff	250 feet east of junction of Natali Road and levee road on north bank; 100 feet of mudbank; approximately 30 percent cover	30 ft^2
Stockton West	Burns Cutoff	100 feet northwest of "pumping station" on south bank, on log	1 ft^2
Stockton West	Burns Cutoff	400 feet southwest of "pumping station" on south bank, on log	5 ft^2
Holt	Middle River	Eastern tip of instream island located approximately 1 mile (5,200 feet) NW of tide gauge at Highway 4 bridge; two subpopulations covering 200 (northeast tip) and 300 (southeast of tip) feet of mudbank	500 ft^2
Holt	Middle River	Discontinuous patches around instream island located approximately 3,300 feet northwest of tide gauge at Highway 4	400 ft^2
Holt	Middle River	Discontinuous patches around instream island located approximately 1,300 feet NW of tide gauge at Highway 4	150 ft^2
Holt	Middle River	Discontinuous patches around island located approximately 700 feet NW of tide gauge at Highway 4 bridge	200 ft^2
Holt	Victoria Canal	Discontinuous patches (five subpopulations) located along the north bank of island separating Victoria and North canals; populations extend 1,300 feet SW of eastern tip of the island	740 ft^2
Union Island	Old River	On SE bank of river approximately 2,000 feet NNE of junction of Bethany and Lammers roads	80 ft^2

QUADRANGLE (USGS 7½')	WATERWAY	LOCATION/DESCRIPTION	SQUARE FOOTAGE
Woodward Island	Middle River	On small island beneath powerline located approximately 1,000 feet S of Mokelumne Aqueduct crossing	10 ft^2
Woodward Island	Middle River	On NE and S sides of island located approximately 2,300 feet SE of Mokelumne Aqueduct crossing	500 ft^2
Woodward Island	Middle River	On northern tip of island located approximately 2,600 feet S of Mokelumne Aqueduct crossing, two subpopulations	100 ft^2
Woodward Island	Middle River	On SW side of large island located approximately 5,000 feet S of AT&SF RR bridge	50 ft^2
Woodward Island	Middle River	On north bank of large irregular-shaped island located approximately 1,500 feet NW of Woodward Island ferry crossing, three subpopulations found from the island's eastern tip to 1,700 feet westward along the northern bank	300 ft^2
Woodward Island	Middle River	On small island (not indicated on the 1978 USGS 7.5' topographic quadrangle) approximately 350 feet north of Woodward Island ferry crossing; a discontinuous band around the island	400 ft^2
Woodward Island	Middle River	On long and narrow island approximately 500 feet SE of Woodward Island ferry crossing, population forms discontinuous band around island except for the middle third of the SW bank	1,100 ft^2
Woodward Island	Middle River	On triangular shaped island located off the eastern tip of Woodward Island, two subpopulations, one along the entire northeast bank and one at the SW tip of the island; cover is dominated by *Limosella subulata* with a smaller amount of *Lilaeopsis*	400 ft^2
Woodward Island	Middle River	Discontinuous band around small narrow NW trending island located approximately 2,000 feet SE of Woodward Island Ferry crossing	500 ft^2

QUADRANGLE (USGS 7½')	WATERWAY	LOCATION/DESCRIPTION	SQUARE FOOTAGE
Woodward Island	Middle River	On large island directly east of confluence with Woodward and North Victoria canals; four subpopulations scattered over 700 feet of the island's north bank	250 ft^2
Woodward Island	Middle River	On northern tip of triangular island located approximately 3,000 feet SE of confluence with Woodward and North Victoria canals; two subpopulations within 200 feet	100 ft^2
Woodward Island	Middle River	Discontinuous band along north bank of large island located approximately 5,000 feet SE of confluence with Woodward and North Victoria canals; population continues onto Holt 7½' topographic quadrangle	1,500 ft^2
Woodward Island	Middle River	West bank of large island located approximately 5,000 feet SE of confluence with Woodward and North Victoria canals; population spans the area 700 to 900 feet SE of powerline crossing	200 ft^2
Woodward Island	Victoria Canal	On north bank of island separating Victoria and North canals approximately 1,700 feet WSW of junction of CalPack and Klein roads (on Holt 7.5' topographic quadrangle; approximately located along the quad boundary)	200 ft^2
Woodward Island	Woodward Canal	On north and east banks of most easterly island separating Woodward and North Victoria canals	300 ft^2
Woodward Island	Woodward Canal	On north bank of island separating Woodward and North Victoria canals approximately 400 feet west of island's eastern end (as shown on the USGS 7.5' topographic quadrangle; the long island shown is actually eroded into two separate islands and this population occurs at the western and larger remnant)	200 ft^2
Woodward Island	Old River	Discontinuous patches on east and south banks of island, located under the AT&SF RR bridge at Orwood	30 ft^2

QUADRANGLE (USGS 7½')	WATERWAY	LOCATION/DESCRIPTION	SQUARE FOOTAGE
Woodward Island	Old River	On all sides of island located 700 feet south of powerline crossing from Woodward Island to Orwood Tract	1,000 ft^2
Woodward Island	Old River	At base of west levee bank spanning the area from 1,400 to 2,100 feet south of powerline crossing from Woodward Island to Orwood Tract; six subpopulations	25 ft^2
Woodward Island	Old River	All around triangular Island located approximately 2,500 feet south of powerline crossing from Woodward Island to Orwood Tract	1,000 ft^2
Woodward Island	Old River	At base of west levee bank, SE exposure, approximately 2,500 feet S of powerline crossing from Woodward Island to Orwood Tract, near eastern tip of Orwood Tract	5 $ft.^2$
Woodward Island	Old River	At base of west levee approximately 1,100 feet WSW of eastern tip of Orwood Tract	5 $ft.^2$
Woodward Island	Old River	All around a linear-shaped island just south of the eastern tip of Orwood Tract	1,500 $ft.^2$
Woodward Island	Old River	At base of west levee approximately 1,700 feet WSW of tip of Orwood Tract; two subpopulations	10 $ft.^2$
Woodward Island	Old River	Along the western levee base at mouth of Indian Slough, two subpopulations found at the tip of the confluence, more northern population consist of a few plants; more continuous patch at confluence	60 $ft.^2$
Woodward Island	Old River	At base of east levee bank, approximately 3,500 feet N of gaging station at Highway 4 bridge, plants rooted in sand over 700 feet of reach	700 $ft.^2$
Woodward Island	Old River	At base of eastern levee bank approximately 1,500 feet NE of gaging station at Highway 4 bridge	1 $ft.^2$

QUADRANGLE (USGS 7½')	WATERWAY	LOCATION/DESCRIPTION	SQUARE FOOTAGE
Woodward Island	Old River	At base of west levee bank approximately 3,100 feet SSW of gaging station at Highway 4 bridge	2 ft.^{2}
Woodward Island	Old River	On old pilings along eastern levee bank approximately 5,200 feet SSW of gaging station at Highway 4 bridge	2 ft.^{2}
Woodward Island	Indian Slough	On piling on north side of channel very near the confluence with Old River	1 ft.^{2}
Woodward Island	Indian Slough	On base of levee north bank of channel approximately 500 feet west of confluence with Old River; two subpopulations	4 ft.^{2}
Woodward Island	Indian Slough	On base of levee north bank of channel approximately 1,200 feet west of confluence with Old River	5 ft.^{2}
Woodward Island	Indian Slough	On south bank of roundish island found in eastern portion of St. Mary's Bay	700 ft.^{2}
Woodward Island	Indian Slough	Northern bank of Island that divides Indian Slough beginning at St. Mary's Bay to point of timber; a discontinuous bank approximately 3,000 feet lower occurring from berm near the northern tip of the island south and west and half way to point of timber. The remaining channel is riprapped.	3,000 ft.^{2}
Clifton Court	Old River	On outer levee base of Victoria Island approximately 2,400 feet NW of the NE tip of Widdows Island	1 ft.^{2}
Clifton Court	Old River	On the outer levees base of Byron Tract approximately 1,800 feet NW of the NE tip of Widdows Island	2 ft.^{2}
Clifton Court	Old River	On the outer levee base of Victoria Island approximately 1,200 feet NW of the NE tip of Widdows Island	5 ft.^{2}

QUADRANGLE (USGS 7½')	WATERWAY	LOCATION/DESCRIPTION	SQUARE FOOTAGE
Clifton Court	Old River	On the outer levee base of Victoria Island approximately 1,000 feet NW of the NE tip of Widdows Island	1 ft.^{2}
Clifton Court	Old River	On the outer base of the Victoria Island levee approximately 300 feet NE of the tip of Eucalyptus Island	3 ft.^{2}
Clifton Court	Old River	On north and west shores of island located at the confluence of Old River and West Canal; a large continuous population	4,000 ft.^{2}
Clifton Court	West Canal	At the outer base of the Clifton Court levee approximately 1,650 feet SE of the bridge to Kings Island; one of DWR's monitored populations	1 ft.^{2}
Clifton Court	West Canal	At the outer base of the Clifton Court levee approximately 4,300 feet southeast of the bridge to Kings Island	1 ft.^{2}
Clifton Court	West Canal	Growing on log at the outer base of the Coney Island levee approximately 4,500 feet southeast of the bridge from Clifton Court to Kings Island	3 ft.^{2}
Clifton Court	West Canal	At the outer base of the Coney Island levee approximately 2,500 feet N of the SW tip of the island	2 ft.^{2}
Clifton Court	West Canal	At the outer levee base of the Union Island levee approximately 400 feet SE of the old river gaging station south of Clifton Court	1 ft.^{2}
Clifton Court	Old River	On the northwest shore of Hammer Island	100 ft.^{2}
Clifton Court	Old River	A discontinuous band approximately 2,300 feet long on the N bank of Old River starting 900 feet E of the eastern tip of Hammer Island	1,000 ft.^{2}

QUADRANGLE (USGS 7½')	WATERWAY	LOCATION/DESCRIPTION	SQUARE FOOTAGE
			12 ft.^{2}
Clifton Court	Old River	A discontinuous band approximately 700 feet in length; three subpopulations starting approximately 5,800 feet SE of the eastern tip of Hammer Island	
Clifton Court	Old River	On the southeast tip of island located in the channel where Finck Road (Union Island) climbs the levee top	100 ft.^{2}
Clifton Court	Sugar Cut	On the west side of "Sugar Cut" at the base of the levee approximately 100 feet NE of junction of Bethany and Wicklund roads	10 ft.^{2}
Clifton Court	Old River	Along water side of mainland levee base; a discontinuous population covering approximately 500 feet of shoreline in the top NE corner of Alameda County	250 ft.^{2}
Clifton Court	Grant Line Canal	At outer base of Union Island levee located approximately 1,600 feet SE of gaging station in Old River	1 ft.^{2}
Clifton Court	Grant Line Canal	On north side of island separating Grant Line and Fabian and Bell canals located approximately 300 feet from west end; one of DWR's monitored populations	2 ft.^{2}
Clifton Court	Grant Line Canal	On north side of island separating Grant Line and Fabian and Bell canals; five subpopulations starting 400 feet and extending to 1,800 feet from the island's west end	20 ft.^{2}
Clifton Court	Grant Line Canal	On north side of island separating Grant Line and Fabian and Bell canals located approximately 4,800 feet from the island's west end; one of DWR's monitored populations	4 ft.^{2}
Clifton Court	Grant Line Canal	On north side of island separating Grant Line and Fabian and Bell canals located approximately 5,300 feet from the island's west end	1 ft.^{2}
Clifton Court	Old River	On a stump in Old River near the NE tip of Coney Island approximately 900 feet ENE of the island's pumping station	2 ft.^{2}

QUADRANGLE (USGS 7½')	WATERWAY	LOCATION/DESCRIPTION	SQUARE FOOTAGE
Clifton Court	Victoria Canal	On north bank of island separating Victoria and North canals located along 600 feet of the island's west end	500 ft.^{2}
Clifton Court	Victoria Canal	On north bank of island separating Victoria and North canals located approximately 1,500 feet east of the island's west end	30 ft.^{2}
Clifton Court	Old River	On NE "hook" of Widdows Island; two subpopulations	8 ft.^{2}
Clifton Court	Old River	On log lodged in the outer north levee of Widdows Island located approximately 1,200 feet SW of island's NE "hook"	6 ft.^{2}
Clifton Court	Italian Slough	On SW side of small island located off the northern tip of Clifton Court levee	2 ft.^{2}
Clifton Court	Italian Slough	Discontinuous band around island located 4,500 feet south of the northern tip of the Clifton Court levee	60 ft.^{2}
Clifton Court	Old River	On the outer bank of the Clifton Court N levee directly across from the channel between Widdows and Eucalyptus islands; one of DWR's monitored populations	3 ft.^{2}
Clifton Court	Old River	On the outer base of the Clifton Court N levee directly across from the middle of Eucalyptus Island	1 ft.^{2}
Clifton Court	Old River	On the south shore of Eucalyptus Island approximately 1,300 feet from the island's western tip; four subpopulations	8 ft.^{2}
Clifton Court	Old River	On the N side of the southeastern tip of Eucalyptus Island; four subpopulations	8 ft.^{2}
Clifton Court	Italian Slough	Discontinuous band on islands located at the west end of Italian Slough under the double powerlines. The islands are shown as being connected to the south bank on the USGS topographic map.	100 ft.^{2}

Impact Dredging of lower Old River from West Canal to Indian Slough could affect nine populations of Mason's Lilaeopsis which grow on the levee bases in this waterway. One population is of significant size, approximately 700 square feet; all other populations are small patches, less than 5 square feet in area.

Mitigation Measure Avoidance of the Mason's lilaeopsis populations during channel dredging would prevent unnecessary losses.

Impacts The Proposed Project would result in a direct loss of Mason's lilaeopsis from facilities construction and habitat alteration. Direct losses of Mason's lilaeopsis would occur from the construction of the northern intake to Clifton Court Forebay and the water control barrier on Old River. The northern intake would be located near a small levee bank population of lilaeopsis which would be removed during construction. Construction of the water control barrier on Old River would remove a large and discontinuous population of Mason's lilaeopsis. This population represents the largest colony of Mason's lilaeopsis at the southeastern limit of the plant's distribution. One additional small population is present in Sugar Cut upstream of the barrier site although patches of seemingly suitable habitat are present along the intervening levee bases.

Operation of the water control barriers on Fabian and Bell Canal and Old River would result in an immediate, but potentially short-term loss of plants due to higher minimum water levels. From DWR's monitoring of Mason's lilaeopsis above the temporary barriers (DWR 1994) it appears that the higher water levels eliminated plants from the lower intertidal zone. Plants did not recolonize this zone during the winter after the barrier was opened; however, these findings are confounded by losses due to erosion.

The monitoring studies suggest that losses of Mason's lilaeopsis in the lower intertidal could be mitigated by natural colonization as long as earthen mudbank habitats are open in the intertidal zone (DWR 1994). The establishment of new colonies is made possible because the barriers reduce erosion from recreational boat wave-wash and restore water levels to a "natural" level (Grewell pers. comm.).

Mitigation Measures Avoidance of Mason's lilaeopsis in siting of the northern intake structure and of the barrier on Old River should be incorporated into the facility design. If this is not possible, other mitigation would be required.

The direct impacts of the Proposed Project on Mason's lilaeopsis are small in relation to ongoing threats throughout the plant's range in the south Delta. Of greatest concern is erosion of Mason's lilaeopsis habitat caused by high winter flows and the action of boat wakes during the summer months. These unrelated factors would continue to reduce existing Mason's lilaeopsis populations and potential habitat throughout the Delta. While these endangering factors are not tied to any ISDP action they represent a more significant threat to the species than the direct removal of a few Mason's lilaeopsis colonies by facility construction. Results from many biologists conducting field surveys in the south Delta indicate that Mason's lilaeopsis is capable of colonizing available habitat. For this reason, a narrowly-focused transplant program aimed at replacing specific populations would be less useful to overall conservation of the species than mitigation measures aimed at reducing ongoing impacts to habitat and potential habitat. In this light, direct losses of Mason's lilaeopsis should be mitigated by DWR/USBR participation in a broader scale recovery effort.

Currently, there is no established mechanism for broad scale mitigation of impacts to Mason's lilaeopsis (Shaffer pers. comm.). Such a program is desirable given the continual influx of projects affecting the plant, including water projects and levee maintenance. In consultation with DFG Endangered Plant Program botanists, DWR/USBR should enter into an agreement to assist in the development of a recovery plan for the species. Participation could include funding of staff time to develop the plan or funding of specific research needs as identified by DFG. Such research may include:

1) A synopsis of prior mitigation measures for Mason's lilaeopsis, their outcomes and relative costs, with the purpose of developing a mitigation bank;

2) Identification of privately-owned flooded islands such as Widdow's or Mildred's islands in the south Delta which could be purchased and operated as a habitat mitigation bank. (The success of Donlon Island made land mitigation is discussed briefly in Golden and Fiedler [1991]; made land consists of areas that have been filled in with mixed materials.)

3) Investigate opportunities for the reduction of impacts from recreational boat traffic in key population areas;

4) Identify opportunities for habitat construction in conjunction with levee improvement projects, such as within water-side berms; and

5) Basic biological research as needed to understand habitat requirements, populations dynamics, or refining the knowledge of the species range or response to environmental perturbations.

The limitation of DWR/USBR responsibility in such a program would be determined by relative costs of other commonly proposed mitigation such as purchasing land, transplanting, and monitoring replacement populations.

Impacts of Alternatives

1. *Enlargement of Clifton Court Forebay, Construction of Two Intake Structures, Increased Export Capability, and Construction of Permanent Barriers*

Impact Construction of an intake structure at the confluence of North Victoria Canal and Middle River and widening of this section of Middle River would result in the loss of channel island habitat in these waterways. The islands of Middle River support large populations of Mason's lilaeopsis; 20 lilaeopsis populations are present in the vicinity of the confluence. Local changes in velocity and water level would occur during operation of the intake and would accelerate the loss of this habitat.

Mitigation Measure As discussed previously for rose-mallow and Delta tule pea, islands in this section of Middle River would require erosion protection and new habitat should be created in the process of channel widening.

Impact The placement of permanent barriers would result in losses of Mason's lilaeopsis as described above for the Proposed Project.

Mitigation Measure Mitigation as presented for the Proposed Project would compensate for Mason's lilaeopsis losses.

2. *Reduction of CVP/SWP Exports and Management Reduction of Demand for SWP Water*

No impacts to Mason's lilaeopsis are anticipated as a result of this alternative. Small changes in water levels over time and in certain water years are not expected to harm the long-term survival of Mason's lilaeopsis in the south Delta.

3. *Increased Flows in the San Joaquin River, Modifications of CVP/SWP Exports, Channel Dredging for Agricultural Diversions, Extending and/or Consolidation of Diversions, Screening of Diversions, Improvements to the Skinner Fish Salvage Facility, and Predation Control*

Impact Potential adverse impacts could occur to Mason's lilaeopsis due to the placement of diversion facilities and channel dredging around known populations.

Mitigation Measure Avoidance of known Mason's lilaeopsis populations during the planning and construction of diversion facilities and channel dredging operations would prevent impacts to this plant.

4. *ISDP with an Additional Intake to Clifton Court Forebay at Italian Slough*

Impact The construction of an intake at Italian Slough could accelerate the loss of island habitats in that waterway. Three Mason's lilaeopsis populations are found in Italian Slough, one west of the proposed intake and two on instream islands. Several additional populations are found in the vicinity of Widdows and Eucalyptus islands.

Mitigation Measure Erosion control structures protecting islands in Italian Slough would reduce the impact of augmented flows in this channel.

5. *ISDP without the Northern Intake and with an Expanded Existing Intake*

Impact Three populations of Mason's lilaeopsis occur in West Canal that could be subjected to scour from augmented flows. The island at the northern end of West Canal could also be affected by this alternative.

Mitigation Measure As described under the Proposed Project, island habitats should be protected from the effects of accelerated erosion.

6. *ISDP without the Northern Intake and with an Intake at Italian Slough*

Impact Loss from increased scour in this channel would occur as described for Alternative 5. The magnitude of impacts could be greater under Alternative 6 given the increased velocities.

Mitigation Measure As discussed previously, protection of the instream island habitats would reduce the potential loss.

7. *No Action (maintain existing conditions)*

Continued loss of Mason's lilaeopsis populations would occur through the loss of island habitat, levee bank and vegetation clearing, and other endangering factors.

8. *No Action (maintain conditions as they would exist in the future)*

Continued loss of Mason's lilaeopsis populations would occur through the loss of island habitat, levee bank and vegetation clearing, and other endangering factors.

Brittlescale

Status

Brittlescale (*Atriplex depressa* Jeps.) is classified as a Category 2 candidate species for federal listing. It has no state status. Brittlescale is included on CNPS List 1B: Plants Rare, Threatened, or Endangered in California and Elsewhere.

Distribution

Brittlescale has been recorded from the Sacramento Valley from Glenn and Colusa counties to Yolo County, and from Contra Costa, Madera, Merced, Stanislaus and Tulare counties in the San Joaquin Valley (CNPS 1992, Jones & Stokes Associates 1992).

Habitat Requirements

Brittlescale is found in alkaline soils that are seasonally saturated and sparsely vegetated.

Critical Habitat

No critical habitat has been designated for brittlescale.

Reasons for Decline

Loss of habitat due to conversion to agriculture or urban land uses are responsible for the decline of this species.

Occurrence in the ISDP Area

Newly discovered populations of brittlescale west of Clifton Court Forebay (Jones & Stokes Associates 1992) suggested that appropriate habitats could be present in the ISDP area, particularly on Byron Tract. During 1993 field surveys, one new location was documented in the ISDP area at the east end of Clifton Court Road, inside the fishing access area.

Impacts of the Proposed Project

The one brittlescale population on the northwest corner of Clifton Court Forebay could be impacted during construction of the northern intake.

Mitigation Measures

Impacts to brittlescale could be avoided by fencing the population prior to construction of the new intake. Routing of construction traffic around the south end of Clifton Court Forebay during construction of the northern intake would eliminate any potential impacts.

Impacts of Alternatives

The one brittlescale population on the northwest corner of Clifton Court Forebay could be impacted during construction of the intake at Italian Slough (Alternative 6).

Mitigation Measures

Impacts to brittlescale could be avoided by fencing the population prior to construction.

Delta Mudwort

Status

Delta mudwort (*Limosella subulata* Ives.) has no federal or state status. It is included on CNPS List 2: Plants Rare, Threatened, or Endangered in California, but more Common Elsewhere.

Distribution

Delta mudwort is found in the Sacramento/San Joaquin Delta, along the Sacramento River near Antioch and in Montezuma Slough on Grizzly Island. The plant also has been recorded from Marin County at Drakes Bay, and in Oregon, Washington, and on the Atlantic coast (Munz and Keck 1968, CNPS 1992, NDDB 1992)

Habitat Requirements

Delta mudwort occurs in intertidal fresh- and brackish-water marshes. It grows on exposed mud often associated with Mason's lilaeopsis, aquatic pigmy-weed, or dwarf spike-rush (NDDB 1992).

Critical Habitat

No critical habitat has been designated for this species.

Reasons for Decline

The intertidal habitats available to Delta mudwort are limited. Levee construction and maintenance, recreational boating, and trampling from fishing access are possible threats to Delta mudwort populations (NDDB 1992).

Occurrence in the ISDP Area

Within California, all known populations of Delta mudwort are located in the general vicinity of the ISDP, except for one coastal population in Marin County. In the south Delta, populations have been observed in the Old River near one of the proposed permanent barriers (DWR 1992). Other surveys in the vicinity of the south Delta record Delta mudwort on species lists, but do not provide any detailed maps or site locational information (Jones & Stokes Associates 1990a).

During 1993 surveys, Delta mudwort was found on island habitats in the lower Middle River (15 populations). It is possible that it occurs elsewhere in the south Delta, although it has not been recorded from other local waterways.

Impacts of the Proposed Project

The ISDP would not result in adverse impacts to Delta mudwort.

Mitigation Measures

None required.

Impacts of Alternatives

Construction of an intake structure at the confluence of North Victoria Canal and the Middle River and widening of this section of the Middle River (Alternative 1) would result in the loss of channel island habitat in these waterways. Islands in the Middle River in the immediate vicinity of the confluence support two populations of Delta mudwort. Local changes in velocity and water level would occur during operation of the intake that could accelerate the loss of this habitat.

Mitigation Measures

Erosion control barriers on existing islands and construction of a parallel channel through the southeastern tip of Woodward Island would reduce impacts to some island habitats near the confluence. New island habitat should be created as a part of the channel widening in the Middle River.

Cumulative Impacts

A cumulative impacts analysis will be included in the Draft EIR/EIS to be released in 1996 (Entrix in preparation). In the Administrative Draft EIR/EIS (Entrix 1995) cumulative impacts of the ISDP are discussed in connection with 16 water-related projects that have been proposed in central and northern California that have undergone some type of environmental review. A summary of potentially significant impacts is provided separately for each project. Even though individual projects may have adverse impacts to sensitive plant species due to the loss of riparian vegetation and/or wetland habitats, the potential project-related cumulative effects upon these resources are being addressed by a number of entities through the initiation of actions and programs specifically designed to improve habitat conditions in the Sacramento/San Joaquin Delta (Entrix 1995). These measures are designed to balance the potential effects of existing and future cumulative actions in the Delta, including water resources actions, with appropriate environmental protection efforts for biological resources in the Delta.

While the ISDP, in conjunction with other proposed water-related projects, may have significant cumulative impacts upon certain fisheries resources, it would not result in significant cumulative impacts to endangered, threatened, candidate, or other sensitive plant species discussed in this Biological Assessment. As Entrix (1995) points out in the Administrative Draft EIR/EIS, "the ISDP would not facilitate significant population growth in the central and southern California service areas;" therefore, any potentially significant effects of the ISDP are almost exclusively confined to the Delta and its immediate vicinity. Mitigation measures have been proposed in this Biological Assessment to reduce all potentially significant impacts of the ISDP to less-than-significant levels.

V. SPECIAL-STATUS WILDLIFE

Introduction

Four federal Category 2 candidate species were located in the ISDP area during 1993 field surveys: California black rail, California horned lark, loggerhead shrike, and western pond turtle. Both breeding and non-breeding Swainson's hawks, a state-threatened species were observed throughout the ISDP area. Suitable habitat for two other species, the giant garter snake, a federally- and state-designated threatened species, and the Valley elderberry longhorn beetle (VELB), a federally threatened species, also was found in the ISDP area, although no individuals of either species were observed. Location maps of special-status wildlife observed in the ISDP area are included in Appendix A of this report. Also included in Appendix A are nest locations of other sensitive birds that have no official federal or state status.

Chapter V provides detailed information on the occurrence of sensitive species in the ISDP and also notes casual observations of other special-status birds that may have been observed during migration or in the winter months, but are neither year round residents or breeders in the ISDP area. Table V-1 lists 51 wildlife species which were considered in the writing of this Biological Assessment, but were determined not to be affected by the Proposed Project or any of the alternatives. In many cases, the known distribution of the species does not overlap with the ISDP area. In other cases, the distribution may include the project area, but no suitable habitat for the species was found within the ISDP area. Lastly, other species (mostly birds) were included in Table V-1 because even though they may occasionally be observed in the project area, the regional population would not be impacted by the project.

Information on the majority of species included in Table V-1, including legal status, distribution, habitat requirements, and reasons for decline, is provided in the Phase I Report - Sensitive Species, Interim South Delta Project (MGA 1993). Distribution maps for each species are included in the MGA (1993) report.

Survey Methodology

Wildlife surveys were limited to the ISDP area as identified in Figure IV-1 (Page IV-9). The survey area was defined to include all areas that could sustain direct or related impacts from implementation of any of the proposed ISDP alternatives. Direct impacts include habitat loss from the placement and maintenance of facilities, channel dredging and the placement of dredge spoils on Victoria Island, channel enlargement, and inundation of riparian vegetation and exposed logs or pipes that provided turtle basking habitat as a result of higher water levels in river channels due to barrier placement. Additional justification for the establishment of survey area boundaries is provided in MGA (1993).

Field surveys for wildlife began in February, 1993, and continued through the summer, ending in early October. Late winter and spring surveys focused on wintering birds and amphibians, respectively, while summer surveys focused on mammals, breeding birds, reptiles, and invertebrates. Additional surveys for the giant garter snake were undertaken in 1995. Results of surveys are provided later in this chapter.

Table V-1. Special-Status Wildlife Species Determined Not to be Affected by the ISDP

SPECIES	LEGAL STATUS* FEDERAL/STATE	DISTRIBUTION DOES NOT OVERLAP WITH ISDP AREA	NO SUITABLE HABITAT PRESENT	OCCURS IRREGULARLY OR IN LOW NUMBERS AND INDIVIDUALS AND REGIONAL POPULATIONS NOT EXPECTED TO BE ADVERSELY AFFECTED BY THE PROJECT
MAMMALS				
Salt marsh harvest mouse (*Reithrodontomys raviventris*)	E/E	X	X	
San Joaquin kit fox (*Vulpes macrotis* ssp. *mutica*)	E/T	X		
Riparian brush rabbit (*Sylvilagus bachmani riparius*)	C1/CSC	X		
San Francisco dusky-footed woodrat (*Neotoma fuscipes annectens*)	C2/--	X	X	
San Joaquin Valley woodrat (*Neotoma fuscipes riparia*)	C2/CSC	X		
Point Reyes jumping mouse (*Zapus trinotatus orarius*)	C2/--	X		
Point Reyes mountain beaver (*Aplodontia rufa phaea*)	C2/--	X		
Spotted bat (*Euderma maculatum*)	C2/--	X	X	
Pacific western big-eared bat (*Plecotus townsendii townsendii*)	C2/CSC	X	X	
Greater western mastiff bat (*Eumops perotis californicus*)	C2/-	X	X	
Salt marsh vagrant shrew (*Sorex vagrans halicoetes*)	C1/CSC	X	X	

SPECIES	LEGAL STATUS* FEDERAL/STATE	DISTRIBUTION DOES NOT OVERLAP WITH ISDP AREA	NO SUITABLE HABITAT PRESENT	OCCURS IRREGULARLY OR IN LOW NUMBERS AND INDIVIDUALS AND REGIONAL POPULATIONS NOT EXPECTED TO BE ADVERSELY AFFECTED BY THE PROJECT
Suisun ornate shrew (*Sorex ornatus sinuosus*)	C1/CSC	X	X	
San Pablo vole (*Microtus californicus sanpabloensis*)	C2/--	X	X	
BIRDS				
American white pelican (*Pelicanus erythrorhynchos*)	--/CSC			X
Double-crested cormorant (*Phalacrocorax auritus*)	--/CSC			X
White-faced ibis (*Plegadis chihi*)	--/CSC	winter only		X
Aleutian Canada goose (*Branta canadensis leucopareia*)	E/--	winter only		X
Osprey (*Pandion haliaetus*)	--/CSC	X		X
Sharp-shinned hawk (*Accipiter striatus*)	--/CSC	winter only		X
Cooper's hawk (*Accipiter cooperii*)	--/CSC			X
Ferruginous hawk (*Buteo regalis*)	C2/--	winter only		X
Merlin (*Falco columbarius*)	--/CSC	winter only		X

SPECIES	LEGAL STATUS* FEDERAL/STATE	DISTRIBUTION DOES NOT OVERLAP WITH ISDP AREA	NO SUITABLE HABITAT PRESENT	OCCURS IRREGULARLY OR IN LOW NUMBERS AND INDIVIDUALS AND REGIONAL POPULATIONS NOT EXPECTED TO BE ADVERSELY AFFECTED BY THE PROJECT
American peregrine falcon (*Falco peregrinus anatum*)	E/E	winter only		X
Greater sandhill crane (*Grus canadensis tabida*)	--/T	winter only		X
Burrowing owl (*Athene cunicularia*)	--/CSC			X
Short-eared owl (*Asio flammeus*)	--/CSC	winter only		X
Tricolored blackbird (*Agelaius tricolor*)	C2/CSC	X		X
REPTILES				
Alameda striped racer (*Masticophis lateralis euryxanthus*)	PE/T	X	X	
AMPHIBIANS				
California red-legged frog (*Rana aurora draytonii*)	PE/CSC		X	
California tiger salamander (*Ambystoma californiense*)	C2/CSC		X	
Western spadefoot toad (*Scaphiopus hammondi hammondi*)	2R/CSC			

SPECIES	LEGAL STATUS* FEDERAL/STATE	DISTRIBUTION DOES NOT OVERLAP WITH ISDP AREA	NO SUITABLE HABITAT PRESENT	OCCURS IRREGULARLY OR IN LOW NUMBERS AND INDIVIDUALS AND REGIONAL POPULATIONS NOT EXPECTED TO BE ADVERSELY AFFECTED BY THE PROJECT
Foothill yellow-legged frog (*Rana boylei*)	C2/CSC	X		
INVERTEBRATES				
Lange's metalmark butterfly (*Apodemia mormo langei*)	E/--	X		
Conservancy fairy shrimp (*Branchinecta conservatio*)	E/--		X	
Longhorn fairy shrimp (*Branchinecta longiantenna*)	E/--		X	
Vernal pool fairy shrimp (*Branchinecta lynchi*)	T/--		X	
San Joaquin dune beetle (*Coelus gracilis*)	C1/--		X	
Vernal pool tadpole shrimp (*Lepidurus packardi*)	E/--		X	
Ciervo aegialian scarab beetle (*Aegialia [aegialia] concinna*)	C2/--		X	
Antioch Dunes anthicid beetle (*Anthicus antiochensis*)	C2/--		X	
Sacramento anthicid beetle (*Anthicus sacramento*)	C2/--		X	
Sacramento Valley tiger beetle (*Cicindela hirticollis abrupta*)	C2/--		X	

SPECIES	LEGAL STATUS* FEDERAL/STATE	DISTRIBUTION DOES NOT OVERLAP WITH ISDP AREA	NO SUITABLE HABITAT PRESENT	OCCURS IRREGULARLY OR IN LOW NUMBERS AND INDIVIDUALS AND REGIONAL POPULATIONS NOT EXPECTED TO BE ADVERSELY AFFECTED BY THE PROJECT
Antioch cophuran robberfly (*Cophura hurdi*)	C2/--		X	
Curved-foot hygrotus diving beetle (*Hygrotus curvipes*)	C2/--		X	
Middlekauff's shield-backed katydid (*Idiostatus middlekauffi*)	C2/--		X	
Hurd's metapogon robberfly (*Metapogon hurdi*)	C2/--		X	
Antioch mutillid wasp (*Myrmosula pacifica*)	C2/--		X	
Yellow-banded andrenid bee (*Perdita hirticeps luteocincta*)	C2/--		X	
Antioch andrenid bee (*Perdita scitula antiochensis*)	C2/--		X	
Antioch sphecid wasp (*Philanthus nasalis*)	C2/--		X	
Delta June beetle (*Polyphylla stellata*)	C2/--		X	

* Status Explanations:

Federal

E = Listed as endangered under the federal Endangered Species Act.

T = Listed as threatened under the federal Endangered Species Act.

PE = Proposed as endangered.

C1 = Category 1 candidate for federal listing. Category 1 includes species for which the USFWS has sufficient biological information to support a proposal to list as endangered or threatened.

C2 = Category 2 candidate for federal listing. Category 2 includes species for which the USFWS has some biological information indicating that listing may be appropriate but for which further biological research and field study are usually needed to clarify the most appropriate status. Category 2 species are not necessarily less rare, threatened, or endangered than Category 1 species or listed species; the distinction relates to the amount of data available and is therefore administrative, not biological.

2R = Recommended by the USFWS for inclusion as a Category 2 candidate in the next update of the candidate species list.

State

-- = No designated special status.

E = Listed as endangered under the California Endangered Species Act.

T = Listed as threatened under the California Endangered Species Act.

CSC = California species of special concern.

Results

Detailed results of wildlife observations are discussed by species later in this chapter. In summary, 40 Swainson's hawk nests were monitored in the ISDP area and numerous non-breeding Swainson's hawks were observed. California black rails were documented from two islands in the Middle River. The western pond turtle was documented in all main waterways of the ISDP area. Habitat suitable for the giant garter snake was located in the slower moving sloughs, especially in the southern portion of the ISDP area along Old River and Tom Paine Slough. Elderberry, the host plant for the VELB, is scattered along the levees throughout the ISDP area; however, no emergence holes characteristic of this species were discovered. Incidental observations of the loggerhead shrike and California horned lark were noted during the breeding season; however, neither species was designated as a Category 2 candidate until after our field surveys were concluded. Therefore, no detailed surveys were conducted for either species.

BIRDS

Swainson's Hawk

Status

The Swainson's hawk (*Buteo swainsoni*) is listed by DFG as a threatened species. It has no federal status. No critical habitat has been designated for this species.

Distribution

The breeding range of the Swainson's hawk includes western Canada, the western United States, and northern Mexico. In September, following the breeding season, Swainson's hawks migrate to Argentina, Uruguay, and southern Brazil. This is a round-trip journey that in some cases may exceed 14,000 miles. Wintering birds return to North America to begin nesting in early March.

The breeding population of Swainson's hawks in California is estimated at 550 pairs with 430 pairs in the Central Valley (Estep 1989). The Central Valley population is concentrated in Yolo, San Joaquin, and Sacramento counties. In 1990, 92 pairs were located in San Joaquin County (Jones & Stokes Associates 1990b). Recently, a small population of 20 to 30 individuals has been discovered to regularly winter in the Sacramento/San Joaquin River Delta (Holt personal observation).

Habitat Requirements

Suitable foraging habitat is necessary to provide an adequate energy source for breeding adults and nestlings. Telemetry studies to determine foraging requirements have shown that Swainson's hawks may use in excess of 15,000 acres of habitat or range up to 18 miles from a nest in search of prey (Estep 1989, Babcock 1993). During the breeding season the preferred prey item is the California

vole (*Microtus californicus*), although a variety of other rodents, birds, and insects may be taken (Estep 1989). Swainson's hawks typically hunt on the wing rather than from a perch like red-shouldered (*Buteo lineatus*) or red-tailed (*Buteo jamaicensis*) hawks, and they have adapted to forage primarily in agricultural fields. DFG (1994) lists preferred foraging habitats for Swainson's hawks as alfalfa; fallow fields; beet, tomato, or other low growing crops; dry land and irrigated pasture; rice land (during the non-flooded period); and cereal grain crops (including corn after harvest).

Estep (1989) found that 73.4 percent of observed prey captures were in fields being harvested, disced, mowed, or irrigated. Foraging opportunities result when voles or other small rodents are displaced from their protective cover and are accessible for capture. Unsuitable foraging habitat types include vineyards, orchards, and cotton fields. These crops have a vegetational structure which makes prey species inaccessible to Swainson's hawks.

Typical nesting habitats are riparian corridors or isolated trees within efficient flying distance of suitable foraging habitat. Tree species commonly selected are Valley oak (*Quercus lobata*), Fremont's cottonwood (*Populus fremontii*), and willow (*Salix* spp.). More than 85 percent of Swainson's hawk nesting territories in the Central Valley are along riparian corridors (Bloom 1980, Estep 1989).

Reasons for Decline

The Swainson's hawk population in California has declined by as much as 91 percent since the turn of the century (Bloom 1980). DFG (1994) attributes this decline to the loss of native nesting and foraging habitats, and more recently, to the conversion of agricultural lands to urbanization and incompatible agricultural crops. In addition, pesticides, shooting, disturbances at the nest site, and impacts on wintering areas may have contributed to the population decline. Although losses on the wintering areas in South America may occur, it is not considered to be a significant factor in the overall decline of the species because breeding populations outside of California remain stable.

In California, the loss of nesting habitat within riparian zones has been accelerated by flood control practices and bank stabilization programs. Smith (1977) estimated that in 1850 over 770,000 acres of riparian habitat were present in the Sacramento Valley. In 1984, Warner and Hendrix estimated that there were only 120,000 acres of riparian habitat remaining in the Sacramento and San Joaquin Valleys. Based on Warner and Hendrix's (1984) estimates approximately 93 percent of the San Joaquin Valley, and 73 percent of the Sacramento Valley riparian habitats, have been eliminated since 1850.

Survey Methodology

NDDB and DFG raptor records were inventoried for previously-recorded nest locations within the ISDP area. Field surveys were conducted during the nesting season from late March through early August. Nesting territories on the levees, or islands in the project area, were located primarily by biologists navigating the sloughs and rivers by boat. Nesting territories were also located while driving, walking, or bicycling along project area waterways.

Results

Forty Swainson's hawk nesting territories were documented in the ISDP area during the 1993 breeding season (see Appendix A, Figures A-2, A-6, A-8, A-9, A-12, A-14, A-15, A-16, A-17, A-18, A-19, A-20, A-21, and A-22). Table V-2 provides locational information, nest tree type, and number of chicks per nest, where known, for these 40 nests. Twenty-four nests (60 percent) were located in valley oaks while 10 nests (25 percent) were in Fremont's cottonwoods. Fifteen territories were located on instream islands, while 25 were on levees. Thirty-two nestlings were observed in 21 nests. Twelve adult pairs were unsuccessful in raising young. The breeding success of seven of the 40 active nests could not be determined.

Discussion

The reasons for the failure of 12 nesting attempts cannot be stated with certainty, but a fire in adjacent riparian habitat may have been responsible for one nest's failure. Another territory was located in a popular fishing spot which may have led to incidents of human disturbance. Great-horned owls (*Bubo virginianus*) were thought to have displaced Swainson's hawks at one location and may have been a factor at two other nests. At four territories the plumage characteristics of one or both members of the pair indicated that they may have lacked the maturity to breed successfully. There were also two unusually windy storms during the 1993 nesting season, one in April and one in May, which buffeted nests to the extent that eggs may have been damaged.

The lack of information concerning the breeding success of seven nesting territories was largely the result of an inability to easily access parts of the study area (e.g., upper San Joaquin River, upper Middle River, Tom Paine Slough, and Paradise Cut). Initial surveys identified a nesting territory, but repeat visits which could gather additional data were sometimes discouraged by low water levels or other navigation hazards such as thick mats of water hyacinth which blocked the channel.

Nest productivity data exists for 33 nesting territories, 21 of which produced 32 young. This is a rate of 1.03 chicks per territory and 1.52 chicks per successful territory. These reproduction rates are comparable with other surveys undertaken in the Central Valley (USFWS 1994).

Nesting territories beyond the confines of the ISDP area were not searched for, but an inventory of recorded nesting territories (Jones & Stokes Associates 1990b, NDDB 1992) is consistent with the opinion that more than 85 percent of Swainson's hawk nesting territories in the Central Valley occur in riparian corridors. Thus, it is likely that more than 85 percent of the Swainson's hawk nesting population in the South Delta is represented in this survey.

It is common for Swainson's hawk breeding pairs to return to the same nesting territory year after year; however, they do not always use the same nest tree (USFWS 1994). It is to be expected that in the future breeding pairs will often nest in trees different than the ones used in 1993.

A population of Swainson's hawks has recently been confirmed to be wintering in the Delta (Yee *et al.* 1991, Holt in preparation). This population appears to concentrate its activities in the north central portion of the Delta and has not been observed in the ISDP area (Holt in preparation).

Table V-2. Swainson's Hawk Nesting Territories in the ISDP Area, 1993

MAP	UTM COORDINATES	LOCATION	NEST TREE	NO. OF CHICKS
STOCKTON WEST 7.5' TOPOGRAPHIC QUADRANGLE				
1.	E.644040 N.4200295	Left bank of Burns Cut near Daggett Road	Cottonwood	2
2.	E.645900 N.4199565	Left bank of San Joaquin River near Stockton sewer ponds	Cottonwood	1
LATHROP 7.5' TOPOGRAPHIC QUADRANGLE				
3.	E.647530 N.4191830	Left bank of San Joaquin River near Bowman Road	English walnut	0
4.	E.647600 N.4190420	Left bank of San Joaquin River near Manilla Road	Valley oak	2
5.	E.647720 N.4189650	Left bank of San Joaquin River near Frewert Road	Cottonwood	1
6.	E.648120 N.4188850	Left bank of San Joaquin River near De Lima Road	Valley oak	1
7.	E.648700 N.4187680	Left bank of San Joaquin River near Dos Reis Road	Cottonwood	1
8.	E.648500 N.4187500	Left bank San Joaquin River near Undine Road	Valley oak	2
9.	E.645980 N.4186800	Right bank of Old River near Roberts Road	Valley oak	3
10.	E.649940 N.4180530	Oxbow right bank of San Joaquin River	Cottonwood	unknown
11.	E.648490 N.4180260	Left bank of Paradise Cut near Union Pacific railroad	Cottonwood	unknown

MAP	UTM COORDINATES	LOCATION	NEST TREE	NO. OF CHICKS
12.	E.645680 N.4180770	Left bank Tom Paine Slough near Berry Ave.	Valley oak	1
13.	E.645330 N.4183580	Island Paradise Cut near Alder Ave.	Valley oak	unknown
14.	E.643920 N.4184550	Island Paradise Cut near Paradise Road	Cottonwood	0
UNION ISLAND 7.5' TOPOGRAPHIC QUADRANGLE				
15.	E.642580 N.4192530	Left bank Middle River near Howard Road	Valley oak	1
16.	E.642990 N.4191300	Left bank Middle River near Wing Levee Road	Valley oak	0
17.	E.642560 N.4189570	Left bank Middle River near Undine Road	Valley oak	2
18.	E.641840 N.4182040	Left bank Tom Paine Slough near Canal Blvd.	Valley oak	1
19.	E.639180 N.4183990	Right bank Tom Paine Slough near Sugar Cut	Valley oak	0
20.	E.641040 N.4185210	Island Old River and Paradise Cut	Red willow	0
21.	E.640160 N.4185239	Island Old River and Paradise Cut	Valley oak	0
22.	E.640010 N.4185520	Island Salmon Slough and Old River	Valley oak	3
23.	E.639050 N.4185020	Right bank Old River near Tom Paine Slough	Valley oak	unknown

MAP	UTM COORDINATES	LOCATION	NEST TREE	NO. OF CHICKS
24.	E.638610 N.4186420	Island Salmon Slough near Grant Line Canal	Valley oak	1
25.	E.637020 N.4186730	Left bank Grant Line Canal near Tracy Blvd.	Valley oak	0
26.	E.635420 N.4186730	Island Fabian and Bell Canal near Grimes Road	Pine	1
27.	E.638360 N.4183810	Left bank Old River near Whitehall Road	Valley oak	1
28.	E.637020 N.4185040	Right bank Old River east of Tracy Blvd.	Valley oak	unknown
29.	E.635530 N.4184630	Left bank Old River near Platti Road	Valley oak	1
30.	E.635080 N.4184730	Island Old River near Finck Road	Valley oak	unknown
31.	E.634620 N.4183800	Island Old River near Lammers Road	Valley oak	unknown
CLIFTON COURT FOREBAY 7.5' TOPOGRAPHIC QUADRANGLE				
32.	E.632020 N.4183140	Right bank Old River near Reeve Road	Cottonwood	0
33.	E.631620 N.4183370	Island Old River near Finck Road	Valley oak	0
34.	E.629270 N.4186600	Island Grant Line and Fabian and Bell canals	Alder	2
35.	E.628180 N.4186570	Island Grant Line and Fabian and Bell canals	Cottonwood	0
36.	E.628649 N.4188940	Island Old River near Clifton Court Road	Oregon ash	0

MAP	UTM COORDINATES	LOCATION	NEST TREE	NO. OF CHICKS
37.	E.628240 N.4190650	Island Old River near North Canal	Red willow	2
HOLT 7.5' TOPOGRAPHIC QUADRANGLE				
38.	E.632850 N.4194340	Island Victoria Canal near Middle River	Cottonwood	0
39.	E.640130 N.4194080	Right bank Middle River near Inland Drive	Valley oak	1
40.	E.641820 N.4194080	Right bank Middle River near Stark Road	Valley oak	2

Impacts of the Proposed Project

Impact - Disruption of Nesting Swainson's Hawks. Swainson's hawks could be adversely impacted where nesting territories are close to project-related construction activities. Disturbances from construction activities could be caused by the operation of heavy machinery such as earthmoving equipment, barges, clamshell dredges, cranes, and trucks. Disturbances would be likely to occur at the construction sites of the flow barriers and the fish control structure where Swainson's hawk nesting territories were adjacent or proximate to the construction sites. Disturbances could also occur at nesting territories that are located adjacent to haul roads where trucks and other heavy equipment pass by, and at nests located next to waterways where barges carrying dredges, pile drivers, riprap, etc. pass by. A collision with a nest tree, as well as disturbances in the nesting territory caused by the operation of heavy equipment or, just as importantly, disturbances in the nesting territory resulting from prolonged human presence, have the potential to disrupt the breeding effort. This could result in abandonment of the nesting territory and mortality to eggs or young. This is a potentially significant impact.

Mitigation Measures The following mitigation measures shall be implemented to reduce potential impacts to Swainson's hawks to less-than-significant levels.

- During the Swainson's hawk breeding season (March 1 through August 30), a qualified biologist shall locate and monitor all Swainson's hawk nesting territories in the vicinity of the construction areas. If a Swainson's hawk territory is occupied, all project-related activities that are likely to disrupt reproductive efforts (e.g., the operation of heavy equipment and prolonged human presence) shall not be permitted within a one-quarter-mile zone surrounding the nest tree. This prohibition shall remain in effect throughout the breeding season or until the young have fledged (approximate fledging dates - May 25 to August 21), or until it can be ascertained that the nesting effort has failed. Continued monitoring by a qualified biologist shall be required to observe and advise DWR on the effectiveness of the no-activity zone(s) and to determine when a no-activity zone becomes unnecessary.

- If haul roads used for project-related construction activities pass through a one-quarter-mile zone surrounding an active Swainson's hawk nest tree a qualified biologist shall make a determination as to whether vehicular traffic associated with project-related construction activities should be rerouted during the breeding season. It may be that traffic merely passing through the area will not constitute a disturbance to nesting Swainson's hawks. However, to avoid possible impacts to the nesting hawks, project-related construction activities other than the passage of vehicles along an established roadway shall not be allowed.

- If barge traffic used for project-related construction activities passes through a one-quarter-mile zone surrounding an active Swainson's hawk nest tree a qualified biologist shall make a determination as to whether barge traffic associated with project-related construction activities should be rerouted during the breeding season. It may be that barges merely passing through will not disturb nesting Swainson's hawks. However, to avoid possible impacts to nesting Swainson's hawks, project related-construction activities other than the passage of barges on a waterway shall not be allowed.

- The period from March 1 through April 30 is a critical period during which Swainson's hawks establish nesting territories, construct nests, and lay eggs. Swainson's hawks are particularly

sensitive and susceptible to nest abandonment during these pre-nesting and incubation phases of the reproductive cycle. It is especially important that project-related disruptive activities do not harass breeding adult pairs in potential nesting habitat during this time period. Potentially disruptive activities, including the operation of heavy equipment and prolonged human presence, shall not be allowed from March 1 through April 30 at those construction sites that have suitable nesting habitat within one-quarter of a mile of the site, or that in previous years supported a Swainson's hawk nest within one-quarter mile of the proposed construction site. Swainson's hawk breeding pairs typically have territories that include several potential nest sites and may establish a new nest in a different tree each year. As such, permanent nest sites cannot be identified. Therefore, for management purposes, all potential nest trees in the vicinity of a Swainson's hawk nesting territory should be considered potential nesting habitat.

Impact - Permanent Loss of Swainson's Hawk Foraging Habitat. Approximately 6 acres of agricultural land suitable as Swainson's hawk foraging habitat would be removed from crop production due to the construction of buildings and parking areas associated with the flow barriers. Breeding Swainson's hawks, as well as migrating birds, forage for small rodents primarily in agricultural fields. DFG (1994) has determined that agricultural lands in grains, pasture, alfalfa, row crops, or fallow lands, that are within 10 miles of an active Swainson's hawk nest site constitute potential foraging habitat for Swainson's hawks. The loss of this habitat constitutes a potentially significant impact.

Mitigation Measures DWR shall be responsible for the purchase and maintenance of at least 6 acres of replacement foraging habitat. Replacement foraging habitat shall be cultivated in crops suitable for Swainson's hawk foraging (e.g., alfalfa, grain, or row crops) and shall not be allowed to be planted in crops unsuitable as Swainson's hawk foraging habitat, such cotton, orchards, or grapes. Replacement foraging habitat shall be located in the southern Delta and shall be in the proximity of breeding Swainson's hawks. It is possible that DWR may fulfill mitigation responsibilities for the loss of Swainson's hawk foraging habitat through appropriate financial participation in the San Joaquin County Habitat Conservation Plan (HCP). Although this HCP is not yet available as a vehicle to facilitate mitigation it is expected to be adopted in 1997.

Impact - Temporary Loss of Swainson's Hawk Foraging Habitat. Approximately 600 acres of agricultural cropland that provides foraging habitat for Swainson's hawks on Victoria Island is to be temporarily taken out of agricultural production and used to support two 300-acre storage ponds. These ponds are to contain dredge spoils until the spoils dry out, a process taking from 2 to 5 years. The spoils would then be used in a separately permitted project, most likely involving reinforcement of the Victoria Island levees. This would constitute a less-than-significant impact to Swainson's hawks.

However, should subsequent plans for the dredge spoils not come to fruition, and the 600 acres of land on Victoria Island be removed from agricultural production on a permanent basis, this loss of foraging habitat would be considered a significant impact to Swainson's hawks.

Mitigation Measures No mitigation measures are necessary if the impact is temporary because there would be no difference in effect than if the fields were left fallow for a similar time period. However, if the 600 acres of storage ponds on Victoria Island are removed from agricultural production permanently, then the creation of 600 acres of replacement habitat shall be required elsewhere in the south Delta.

One of the ways that DWR can mitigate for the loss of Swainson's hawk foraging habitat would be to enter into a 2080 or 2090 "take" agreement with DFG that specifically provides replacement habitat at a 1:1 ratio. Under this agreement, one acre of habitat must be replaced for every one acre lost. This agreement must be fully executed prior to habitat removal.

Impacts of Alternatives

1. *Enlargement of Clifton Court Forebay, Construction of Two Intake Structures, Increased Export Capability, and Construction of Permanent Barriers*

The following impacts and mitigation measures would apply in addition to the impacts and mitigation measures described previously for the ISDP.

Impact - Loss of Swainson's Hawk Foraging Habitat. The loss of as much as 2,900 acres of cropland that is suitable as foraging habitat for Swainson's hawks on Victoria Island and the loss of an undetermined amount of cropland on Lower Jones Tract which also provides foraging habitat for Swainson's hawks would be a potentially significant impact.

Mitigation Measures Replacement habitat shall be provided on an acre-per-acre basis.

Impact - Loss of Swainson's Hawk Nesting Habitat. The intake structure at the confluence of Middle River and Victoria Canal would likely cause the erosion, due to scouring from increased flows, of islands adjacent to the intake structure. A Swainson's hawk nest tree is located on that island. This constitutes a potentially significant impact.

Mitigation Measures To reduce this impact to less-than-significant levels construction of erosion protection structures and possibly the creation of replacement nesting habitat would be necessary.

Impact - Potential Disruption of Nesting Swainson's Hawks. The intake structure at the confluence of Middle River and Victoria Canal lies adjacent to an active Swainson's hawk nest territory. Construction activities at that location could disrupt the breeding efforts of Swainson's hawks. This is a potentially significant impact.

Mitigation Measures Mitigation measures provided for the Proposed Project would also apply to this impact.

2. *Reduction of CVP/SWP Exports and Management Reduction of Demand for SWP Water*

Impact This alternative would not affect the Swainson's hawk. Nest trees on project area levees would remain and adjacent lands would continue in their present agricultural uses.

Mitigation Measures None required.

3. *Increased Flows in the San Joaquin River, Modifications of CVP/SWP Exports, Channel Dredging for Agricultural Diversions, Extending and/or Consolidation of Diversions, Screening of Diversions, Improvements to the Skinner Fish Salvage Facility, and Predation Control*

Impact - Potential Loss of Swainson's Hawk Nesting Habitat. Numerous Swainson's hawk nesting territories are located in the vicinity of Fabian Tract, Roberts Island, and Union Island. It is likely that project-related activities performed when dredging at the consolidated diversion points, and/or during construction of the irrigation water conveyance systems on Fabian Tract, Roberts Island, and Union Island would eliminate active or potential Swainson's hawk nesting habitat.

Mitigation Measure Avoidance of impact where possible and creation of replacement habitat when impact is unavoidable.

Impact - Potential to Disrupt Nesting Swainson's Hawks. Numerous Swainson's hawk nesting territories are located in the vicinity of Fabian Tract, Roberts Island, and Union Island. It is likely that project-related activities performed when dredging at the consolidated diversion points, and/or during construction of the irrigation water conveyance systems on Fabian Tract, Roberts Island, and Union Island could disrupt Swainson's hawks at their nesting territories.

Mitigation Measures Avoidance of impacts with mitigation measures similar to those recommended for the Proposed Project.

Impact - Loss of Swainson's Hawk Foraging Habitat. Construction of irrigation water conveyance systems on Fabian Tract, Roberts Island, and Union Island would likely remove agricultural lands from cultivation that provide Swainson's hawk foraging habitat.

Mitigation Measures Creation of suitable replacement habitat.

4. *ISDP with an Additional Intake at Italian Slough*

Impacts The construction of an additional intake at Italian Slough should not have an impact on Swainson's hawks.

Mitigation Measures No mitigation measures in addition to those discussed for the ISDP would be necessary.

5. *ISDP without the Northern Intake and with an Expanded Existing Intake*

Impacts The expansion of the existing intake structure would not impact Swainson's hawks.

Mitigation Measures No mitigation measures in addition to those discussed for the ISDP are necessary.

6. *ISDP without the Northern Intake and with an Intake at Italian Slough*

Impacts These changes in the location of the construction area for the intake structure would not impact Swainson's hawks.

Mitigation Measures No mitigation measures in addition to those discussed for the ISDP are necessary.

7. *No-Action (Maintain Existing Conditions)*

Impact This No-Action Alternative would not affect the Swainson's hawk. Nest trees on project area levees would remain intact and adjacent lands would continue in their present agricultural uses.

Mitigation Measures None required.

8. *No-Action (Maintain Conditions as they will Exist in the Future)*

Impact This No-Action Alternative would not affect the Swainson's hawk. Nest trees on project area levees would remain intact and adjacent lands would continue in their present agricultural uses.

Mitigation Measures None required.

California Black Rail

Status

The California black rail (*Laterallus jamaicensis coturniculus*), a subspecies of black rail (*L. jamaicensis*), is designated as a Category 2 candidate for listing by the USFWS. It is listed by DFG as threatened. No critical habitat has been designated for this species.

Distribution

The California black rail breeds in limited numbers in coastal salt marshes from the San Francisco/San Pablo/Suisun Bay estuaries south to northern Baja California, Mexico. It also breeds in inland freshwater marshes including the lower Colorado River, the Salton Sea, and the Sacramento/San Joaquin River Delta. There is a wider distribution during the non-breeding season (American Ornithologist's Union 1983, Ripley 1977, Ripley and Beehler 1985).

Habitat Requirements

California black rails are secretive birds; therefore, habitat requirements have been difficult to assess. Little is known about black rail food habits but it is thought that they consume arthropods (Huey 1916). Grinnell and Miller (1944) described the habitat preferred by black rails as "chiefly tidal salt marshes, where associated characteristically with heavy growths of pickleweed (*Salicornia*)... but also occurs in brackish and freshwater marshes...". Repking and Ohmart (1977) and Manolis (1978) found a definite relationship between black rail distribution and marsh elevation. They found black rails in high, shallow water marshes with little annual and/or daily fluctuations in water level, but not in low, deep water marshes or marshes with considerable fluctuations in water level. Grinnell and Miller (1944) stated that for black rails, the "most important hazards ... appear to be extra high tides". Manolis (1978) found that black rails were absent from areas completely submerged by high tides. A gradual slope into upland marsh appears to be a necessity. Inundation of nests can mean failure of the reproductive effort. Inundation of habitat has been documented as a cause of black rail mortality (Evens and Page 1986), due to predation by carnivorous birds when rising water eliminates protective cover.

Suitable habitat remaining in the ISDP area are tidally-influenced berm islands that have a dense *Typha/Scirpus* vegetative cover and that additionally possess an element of upland habitat, usually identified by the presence of willow (*Salix* spp.) and/or redstem or creek dogwood (*Cornus stolonifera* var. *californica*).

Reasons for Decline

Enormous amounts of California's wetlands have been drained and converted to such uses as agriculture, urban development, airports, and salt evaporation sites. Prior to 1853, coastal wetlands were estimated to total 253,000 acres; this amount has been reduced to less than 51,000 acres, more than an 80 percent loss (ESA/Madrone 1982). Also, prior to 1853, interior wetlands were estimated to be in excess of 4,000,000 acres. In 1982, ESA/Madrone estimated that just 40,000 acres of interior wetlands remained, more than a 99 percent loss. Tidal marshes once occupied more than 300 square miles around the margins of the San Francisco, San Pablo, and Suisun bays. Today, less than 19 percent of this habitat remains (Gill and Buckman 1974). In San Diego Bay, where the black rail has been extirpated, only 10 to 15 percent of marsh habitat remains (Browning and Speth 1973, Mudie 1970).

Survey Methodology

Records from the NDDB and other sources were inventoried to determine known locations of black rails in and near the ISDP area. Potential habitat within the project area was identified from maps, aerial photographs, and from boat reconnaissance surveys. Eighteen areas were classified as being potentially suitable habitat for black rails, i.e., berm islands in Middle River, Indian Slough, and Victoria and North canals. These habitat areas were then surveyed on nine occasions from April 28 through July 1, 1993. Early daylight hours from dawn to about 10 a.m. were deemed suitable for censusing (Gifford pers. comm., Manolis pers. comm.).

Black rails are extremely secretive and only rarely observed. The surest indication of their presence is their vocalizations. A tape of black rail calls featuring the "kiki do" and both low and intense "grrrr" calls was played from a portable tape machine to elicit vocalizations. Usually the tape was played for one or more minutes and then turned off for one or more minutes, listening all the while for a response. After 10 minutes at one station the process was discontinued and then repeated at another station approximately 100 yards away. When the wind exceeded approximately 10 mph, censusing was discontinued because wind limits the distance sound carries.

One hundred and twenty-five stations on 18 berm islands were surveyed in this manner. The procedure was replicated on different days at several of the islands with the most promising habitat. At some locations a third attempt to elicit a response was made.

Results

Positive responses were received from two berm islands in the Middle River (see Appendix A, Figures A-2 and A-5. At least three different individuals responded, and possibly as many as five. Because of the distance from the boat to the sound of the calls, it is not known whether more than one individual responded from one island or the same individual responded several times.

Discussion

All positive responses elicited were "kiki do" and low "grrrr" calls. The "kiki do" call is thought to be given by the male of the species (Robbins *et al.* 1966). Therefore, assuming that this is a breeding population, an unknown number of females should be considered present as well.

It is perhaps significant that the two habitat islands from which black rail responded are the two largest islands in Middle River. Little is known about minimum habitat size for this species. Some habitat components that black rails may require, include:

- A foraging area adequate to sustain the reproductive effort.
- The availability of alternate foraging areas when water levels are at extremes in the tidal cycle.
- The availability of vegetation for protective cover at tidal extremes.
- A nesting substrate protected from high tides and from boat wakes at medium to high tides.

All of the above conditions can be more easily satisfied in a larger acreage of habitat than in a smaller area.

Impacts of the Proposed Project

The Proposed Project is not expected to adversely impact California black rails.

Mitigation Measures

None required.

Impacts of Alternatives

Only one of the alternatives considered may affect California black rails. Potential impacts are discussed below.

1. *Enlargement of Clifton Court Forebay, Construction of Two Intake Structures, Increased Export Capability, and Construction of Permanent Barriers*

Potential Impact - Loss of Nesting and Foraging Habitat. This alternative could have adverse impacts on California black rails if the habitat deteriorates on the instream islands in Middle River. These instream islands support a population of black rails. If the erosive forces on the banks of the islands are accelerated by the increased flows generated by project diversions, available habitat on these islands would be reduced.

Black rails do not appear to occupy habitats in the Delta smaller than about 15 acres in size. The only documented locations of black rails in the Delta are on instream berm islands which are slowly disappearing. This can be observed by comparing historical aerial photos with more recent ones. Older photos depict numerous instream islands in the main rivers, whereas many of these are absent from the more recent photos. In the foreseeable future, most suitable black rail habitat in the Delta may be eliminated. No new habitat is being created because of the intensively managed river system throughout the Delta.

Mitigation Measures Installation of protective structures, or possibly the creation of replacement habitat on an acre-per-acre basis, as close as possible to the Middle River, would be necessary.

Other Special-Status Birds

The birds discussed in the following section have some type of special status according to federal and/or state governmental agencies. In most cases, the ISDP would not adversely impact regional populations of these species; however, they are included here because individuals may occasionally use agricultural fields or waterways within the project area. In some cases, either the ISDP or one of the alternatives could affect individual pairs of a particular species. Species that may be affected by the ISDP or one of the alternatives are discussed first. Table V-3 provides a summary of legal status and observations of special-status birds in the ISDP area during the 1993 field season.

Greater Sandhill Crane

The greater sandhill crane (*Grus canadensis tabida*) is listed as threatened by DFG. Virtually the entire population of greater sandhill cranes winter in the Central Valley. Approximately 76 percent of that population is known to concentrate in the northern Delta (Pogson and Lindstedt 1991).

Table V-3. Special-Status Bird Species Known or Likely to Occur in the ISDP Area

SPECIES	STATUS Federal/State*	OBSERVED IN PROJECT AREA	NESTING IN PROJECT AREA	HABITAT TYPES			
				AQUATIC (RIVERS, SLOUGHS, CLIFTON COURT FOREBAY)	RIPARIAN FOREST	RIPARIAN MARSH (BERM ISLANDS)	AGRICULTURAL LAND
American white pelican *(Pelecanus erythrorhynchos)*	--/CSC			X			X
Double-crested cormorant *(Phalacrocorax auritus)*	--/CSC	X		X	X		
Great blue heron *(Ardea herodias)*	--/CSC	X	X	X	X	X	X
White-faced ibis *(Plegadis chihi)*	--/CSC					X	X
Aleutian Canada goose *(Branta canadensis leucopareia)*	E/--			X			X
Osprey *(Pandion haliaetus)*	--/CSC	X		X	X		
White-tailed kite *(Elanus leucurus)*	--/FP	X	X		X	X	X
Northern harrier *(Circus cyaneus)*	--/CSC	X	X			X	X
Sharp-shinned hawk *(Accipiter striatus)*	--/CSC				X		
Cooper's hawk *(Accipiter cooperii)*	--/CSC	X			X	X	X

SPECIES	STATUS Federal/State*	OBSERVED IN PROJECT AREA	NESTING IN PROJECT AREA	HABITAT TYPES			
				AQUATIC (RIVERS, SLOUGHS, CLIFTON COURT FOREBAY)	RIPARIAN FOREST	RIPARIAN MARSH (BERM ISLANDS)	AGRICULTURAL LAND
Ferruginous hawk *(Buteo regalis)*	C2/--						X
Swainson's hawk *(Buteo swansoni)*	--/T	X	X		X	X	X
Merlin *(Falco columbarius)*	--/CSC				X	X	X
American peregrine falcon *(Falco peregrinus anatum)*	E/E				X	X	X
California black rail *(Laterallus jamaicensis)*	C2/T	X	X			X	
Greater sandhill crane *(Grus canadensis tabida)*	--/T						X
Burrowing owl *(Athene cunicularia)*	--/CSC						X
Short-eared owl *(Asio flammeus)*	--/CSC					X	X
California horned lark *(Eremophila alpestris actia)*	C2/--	X	X				X
Loggerhead shrike *(Lanius ludovicianus)*	C2/--	X	X		X	X	X
Yellow-breasted chat *(Icteria virens)*	--/CSC	X	X		X	X	
Tricolored blackbird *(Agelaius tricolor)*	C2/CSC					X	X

* Status Explanations:

-- = No designated special status.

Federal

E = Listed as endangered under the federal Endangered Species Act.

C2 = Category 2 candidate for federal listing. Category 2 includes species for which the USFWS has some biological information indicating that listing may be appropriate but for which further biological research and field study are usually needed to clarify the most appropriate status. Category 2 species are not necessarily less rare, threatened, or endangered than Category 1 species or listed species; the distinction relates to the amount of data available and is therefore administrative, not biological.

State

E = Listed as endangered under the California Endangered Species Act.

T = Listed as threatened under the California Endangered Species Act.

CSC = Species of special concern.

FP = Fully protected by the State of California.

Individuals are found in agricultural fields, grain fields, stubble fields, grasslands, and open areas near water. They eat mostly waste cereal grains, insects, and rodents. Although no greater sandhill cranes were observed during the 1992-93 winter field surveys, they could occasionally use agricultural fields within the project area.

Impacts of the Proposed Project The ISDP should not result in impacts to greater sandhill cranes. However, if the dredge spoil storage ponds on Victoria Island are removed from agricultural production permanently and do not revert back to agriculture in 2 to 5 years as is expected, then the loss of that agricultural land (approximately 600 acres) would constitute a permanent loss of foraging habitat for this species.

Mitigation Measures Replacement habitat, on an acre-per-acre basis would have to be created elsewhere in the south Delta.

Impacts of Alternatives The ISDP is a component of Alternatives 1, 4, 5, and 6. Therefore, impacts and mitigation measures discussed for the ISDP would also apply to these alternatives. The following impacts and mitigation measures would be in addition to the ISDP.

1. *Enlargement of Clifton Court Forebay, Construction of Two Intake Structures, Increased Export Capability, and Construction of Permanent Barriers*

Impact - Loss of Greater Sandhill Crane Foraging Habitat. The enlargement of Clifton Court Forebay would inundate 2,900 acres of cropland on Victoria Island. This alternative also proposes to widen Middle River by moving the levee back onto Lower Jones Tract. The loss of as much as 2,900 acres of cropland that provides foraging habitat for greater sandhill cranes on Victoria Island and the loss of an undetermined amount of cropland on Lower Jones Tract constitutes a potentially significant impact.

Mitigation Measures Replacement habitat, on an acre-per-acre basis, would have to be created elsewhere in the south Delta.

California Horned Lark

The California horned lark (*Eremophilia alpestris actia*) is a federal Category 2 candidate species. It is widespread and common to abundant in a variety of suitable, sparsely-vegetated habitats, including grasslands interrupted by bare ground, grassy hillsides, plowed agricultural lands, and deserts. It eats insects and seeds and nests on the ground in the open usually raising two broods a year. After breeding it becomes very gregarious forming large flocks. Horned larks are most abundantly found in grassland habitats in, or near, the foothills of the Central Valley, but they do breed on the Valley floor, usually in bare ground habitats such as fallow fields. They have been observed on levees in the Delta (Holt pers. observation).

Horned larks were observed in the ISDP area during 1993 field surveys in the breeding season (March through July). Individuals were observed flying overhead or on the levees along the Old River, within one-half mile of the barrier site near the Delta-Mendota Canal; on Grant Line Canal within one mile of the barrier site; and on Middle River within one mile of the barrier site. Field surveys of the ISDP area were conducted prior to the species' designation as a federal Category 2

candidate; therefore, horned larks and their nests were not specifically searched for. It is likely, due to their presence in the project area during the breeding season and the availability of suitable habitat, that horned larks were nesting in the vicinity of the above observations.

Impacts of the Proposed Project California horned larks could nest at any of the barrier sites, at the fish control structure, at the intake structure, along levees adjacent to Old River that are to be dredged, or at the dredge spoil storage sites on Victoria Island. Should California horned larks nest in an area that is subject to project-related disturbances, the reproductive effort of those particular pairs could be disrupted.

Impacts of Alternatives The ISDP is a component of Alternatives 1, 4, 5, and 6. Potential impacts to individual pairs of California horned larks could occur under Alternatives 1 and 3. No mitigation measures are required.

1. *Enlargement of Clifton Court Forebay, Construction of Two Intake Structures, Increased Export Capability, and Construction of Permanent Barriers*

California horned larks may nest at various sites including: all other proposed intake sites, and on Victoria Island, Lower Jones Tract, and Byron Tract. Should California horned larks nest in an area that is subject to project-related disturbances, the reproductive effort of those particular pairs could be disrupted.

3. *Increased Flows in the San Joaquin River, Modifications of CVP/SWP Exports, Channel Dredging for Agricultural Diversions, Extending and/or Consolidation of Diversions, Screening of Diversions, Improvements to the Skinner Fish Salvage Facility, and Predation Control*

California horned larks may nest at various sites including: Fabian Tract, Roberts Island, and Union Island. Should California horned larks nest in an area that is subject to project-related disturbances, the reproductive effort of those particular pairs could be disrupted.

Loggerhead Shrike

The loggerhead shrike (*Lanius ludovicianus*) is a federal Category 2 candidate species. It eats insects, but it also is the only passerine bird species that regularly feeds on small rodents, reptiles, and amphibians. It is a bird of the open country, often found in agricultural fields, nesting in small trees or shrubs. Loggerhead shrikes have declined throughout their range, but particularly in the central United States, where pesticides are thought to be problematic (Ehrlich *et al.* 1988).

In the Delta, loggerhead shrikes are uncommon residents (Yee 1990), and there is perhaps an influx of shrikes from colder climates in the winter. Several loggerhead shrikes were observed during 1993 field surveys in the ISDP area perched along the San Joaquin River, Old River, and Clifton Court Forebay. Field surveys were conducted prior to the species' designation as a federal Category 2 candidate; therefore, loggerhead shrikes and their nesting territories were not specifically searched for. It is likely, due to their presence in the project area during the breeding season and the availability of suitable habitat, that shrikes were nesting in the vicinity of the above observations.

Impacts of Proposed Project Loggerhead shrikes may nest at any of the barrier sites, at the fish control structure, at the intake structure, along levees adjacent to Old River that are to be dredged, or at the dredge spoil sites on Victoria Island. Should loggerhead shrike nest in an area that is subject to project-related disturbances, the reproductive effort of that particular pair of shrikes could be disrupted.

Impacts of Alternatives The ISDP is a component of Alternatives 1, 4, 5, and 6. Potential impacts to individual pairs of loggerhead shrikes could occur under Alternatives 1 and 3. No mitigation measures are required.

1. *Enlargement of Clifton Court Forebay, Construction of Two Intake Structures, Increased Export Capability, and Construction of Permanent Barriers*

Loggerhead shrikes may nest at various sites including: all other proposed intake sites, and on Victoria Island, Lower Jones Tract, and Byron Tract. Should loggerhead shrikes nest in an area that is subject to project-related disturbances, the reproductive effort of those particular pairs could be disrupted.

3. *Increased Flows in the San Joaquin River, Modifications of CVP/SWP Exports, Channel Dredging for Agricultural Diversions, Extending and/or Consolidation of Diversions, Screening of Diversions, Improvements to the Skinner Fish Salvage Facility, and Predation Control*

Loggerhead shrikes may nest at various sites including: Fabian Tract, Roberts Island, and Union Island. Should loggerhead shrikes nest in an area that is subject to project-related disturbances, the reproductive effort of those particular pairs could be disrupted.

Great Blue Heron

The great blue heron (*Ardea herodias*) is designated by the DFG as a Species of Special Concern. They nest mainly in colonies, usually in a tall stand of trees near a variety of fresh or saltwater habitats, including swamps, rivers, sloughs, lagoons, estuaries, and lakes. Great blue herons are common Delta residents. In the winter there is an influx of individuals from colder climates. They are opportunistic feeders, typically hunting at the water's edge for fish, reptiles, and amphibians. Great blue herons also forage in agricultural fields for small mammals.

Foraging herons were encountered regularly during 1993 field surveys in the ISDP area. A large colony nests in a eucalyptus grove just north of Clifton Court Forebay on Eucalyptus Island (see Appendix A, Figure A-11). At least 100 nests were counted in this rookery, although not all were being used. A second, smaller nesting area was located in the Middle River on an island immediately south of the AT&SF railroad tracks and East Bay Municipal Utility District pipeline (see Appendix A, Figure A-2). This rookery contained only two or three nests and was also located in a eucalyptus grove.

Impacts of the Proposed Project The ISDP could result in disruption of nesting great blue herons. Perhaps the largest nesting colony of great blue herons in the entire Delta region is located just north of Clifton Court Forebay on Eucalyptus Island. This nesting colony could be impacted by disturbances caused from an estimated 24,720 truck loads of embankment material passing by on the

Clifton Court Forebay levee road. This road lies approximately 500 feet to 1,500 feet from the heron rookery, depending on the exact location in the rookery. If project-related disturbances disrupt this heron colony's reproductive effort it would constitute a significant impact.

Mitigation Measures A qualified biologist should monitor heron reactions to project-related disturbances to determine whether project-related truck traffic is likely to disrupt the reproductive effort. Should that prove to be the case, project-related traffic would need to be rerouted or postponed until such time as the heron colony is no longer vulnerable to disturbance.

Impacts of Alternatives The ISDP is a component of Alternatives 1, 4, 5, and 6. Therefore, impacts and mitigation measures described for the ISDP would also apply to these alternatives.

Northern Harrier

The northern harrier (*Circus cyaneus*) is designated by the DFG as a Species of Special Concern. The number of breeding pairs has declined in California due to the destruction of wetland habitat and native grassland, and the burning and plowing of nesting areas during the breeding season. Northern harriers nest on the ground, mostly in emergent wetland, but may nest in grasslands or grain fields. They forage over open ground such as in fallow fields, grain or row crops, field edges, and irrigation ditches for small mammals, frogs, crustaceans, and insects. Northern harriers can be locally abundant if nesting and foraging conditions are suitable. Harriers were observed on a daily basis in the ISDP area and were seen foraging in adjacent fields. Three nesting territories were identified within the ISDP area on islands in Old and Middle rivers (see Appendix A, Figures A-2, A-5, and A-14).

Impacts of the Proposed Project Northern harriers could nest at any of the barrier sites, at the fish control structure, at the intake structure, along the levees adjacent to Old River that are to be dredged, or at the dredge spoil storage sites on Victoria Island. Should northern harriers nest in an area that is subject to project- related disturbances, the reproductive effort of those individual pairs could be disrupted.

If the dredge spoils storage ponds on Victoria Island are removed from agricultural production permanently and do not revert back to agriculture in 2 to 5 years as is expected, then the loss of that agricultural land would constitute a loss of foraging habitat for northern harriers.

Impacts of Alternatives The ISDP is a component of Alternatives 1, 4, 5, and 6. Potential impacts to individual pairs of northern harriers could occur under Alternatives 1 and 3. Mitigation is not required.

1. *Enlargement of Clifton Court Forebay, Construction of Two Intake Structures, Increased Export Capability, and Construction of Permanent Barriers*

The construction of two new intake structures, and the widening of Middle River downstream from the intake structure to be located at the confluence of Middle River and Victoria Canal, are proposed. The instream islands in the Middle River provide habitat for nesting northern harriers. These islands may be subjected to erosive forces accelerated by the increased flows generated by project diversions, thus eliminating nesting habitat for this species.

Northern harriers could nest at various sites including: all other proposed intake sites, and on Victoria Island, Lower Jones Tract, and Byron Tract. Should northern harriers nest in an area that is subject to project-related disturbances, the reproductive effort of individual pairs could be disrupted.

The enlargement of Clifton Court Forebay as proposed under this alternative would inundate 2,900 acres of cropland on Victoria Island. Middle River would also be widened by moving the levee back onto Lower Jones Tract. This represents a loss of as much as 2,900 acres of cropland that is suitable foraging habitat for northern harriers on Victoria Island and a loss of an undetermined amount of cropland on Lower Jones Tract, which is also suitable as foraging habitat.

3. *Increased Flows in the San Joaquin River, Modifications of CVP/SWP Exports, Channel Dredging for Agricultural Diversions, Extending and/or Consolidation of Diversions, Screening of Diversions, Improvements to the Skinner Fish Salvage Facility, and Predation Control*

Northern harriers could nest at various sites including: Fabian Tract, Roberts Island, and Union Island. Should northern harriers nest in an area that is subject to project-related disturbances, the reproductive effort of the individual pairs could be disrupted.

White-Tailed Kite

The white-tailed kite (*Elanus leucurus*), formerly known as the black-shouldered kite, is a fully protected species according to the California Fish and Game Code. White-tailed kites are found primarily in open agricultural and grassland habitats. This species declined noticeably during the early part of the 20th century (Grinnell and Miller 1944), but is now fairly common in suitable habitats, particularly in the Central Valley. White-tailed kites make a stick nest near the top of dense oaks, willows, cottonwoods, or other trees. Their nesting territories are located near open foraging areas where they can catch voles or other small mammals. Foraging white-tailed kites were observed on a daily basis during 1993 field surveys. At least six breeding pairs were identified along the San Joaquin River, Middle River, Old River, and Grant Line Canal. Nest sites are indicated in Appendix A, Figures A-5, A-14, and A-20.

Impacts of the Proposed Project White-tailed kites could nest in riparian corridors in the vicinity of the flow barriers and haul roads or waterways used by project-related traffic. Should white-tailed kites nest in areas that would be subject to project-related disturbances, the reproductive effort of those individual pairs could be disrupted.

If the dredge spoils storage ponds on Victoria Island are removed from agricultural production permanently and do not revert back to agriculture in the 2 to 5 years as is expected, then the loss of that agricultural land would be a loss of foraging habitat for white-tailed kites.

Impacts of Alternatives The ISDP is a component of Alternatives 1, 4, 5, and 6. Potential impacts to individual pairs of white-tailed kites could occur under Alternatives 1 and 3.

1. *Enlargement of Clifton Court Forebay, Construction of Two Intake Structures, Increased Export Capability, and Construction of Permanent Barriers*

The enlargement of Clifton Court Forebay as proposed would inundate 2,900 acres of cropland on Victoria Island. Middle River also would be widened by moving the levee back onto Lower Jones Tract. This would represent a loss of as much as 2,900 acres of cropland that provides suitable foraging habitat for white-tailed kites on Victoria Island and a loss of an undetermined amount of cropland on Lower Jones Tract, also providing foraging habitat for this species.

3. *Increased Flows in the San Joaquin River, Modifications of CVP/SWP Exports, Channel Dredging for Agricultural Diversions, Extending and/or Consolidation of Diversions, Screening of Diversions, Improvements to the Skinner Fish Salvage Facility, and Predation Control*

White-tailed kites may nest at various sites including: Fabian Tract, Roberts Island, and Union Island. Should white-tailed kites nest in an area that would be subject to project-related disturbances, the reproductive effort of these individual pairs could be disrupted.

Cooper's Hawk

The Cooper's hawk (*Accipiter cooperii*) is designated by the DFG as a Species of Special Concern. The species formerly nested in the lowland riparian woodlands of the Central Valley, but extensive losses of riparian woodland habitat and perhaps pesticide contamination largely have eliminated the Cooper's hawk as a breeding bird there today. A single Cooper's hawk was observed on April 27, 1993 in the ISDP area near Salmon Slough. No nest, nor any breeding activity, was observed at that location or at any other location within the ISDP area.

Cooper's hawks could breed in the ISDP area since suitable riparian woodland for breeding sites does exist. Also, there are a few recent records of Cooper's hawk breeding in San Joaquin County (Yee pers. comm.). In winter, there is an influx of Cooper's hawks into the Central Valley and it is likely that a few Cooper's hawks use the riparian woodlands within the project area in that season.

Impacts of the Proposed Project Cooper's hawks could nest in riparian corridors in the vicinity of the flow barriers and haul roads or waterways used by project-related traffic. Should Cooper's hawks nest in an area that would be subject to project-related disturbances, the reproductive effort of these individuals pairs could be disrupted.

Impacts of Alternatives The ISDP is a component of Alternatives 1, 4, 5, and 6. Potential impacts to individual pairs of Cooper's hawks could also occur under Alternative 3. Mitigation is not required.

3. *Increased Flows in the San Joaquin River, Modifications of CVP/SWP Exports, Channel Dredging for Agricultural Diversions, Extending and/or Consolidation of Diversions, Screening of Diversions, Improvements to the Skinner Fish Salvage Facility, and Predation Control*

Cooper's hawks could nest at various sites including: Fabian Tract, Roberts Island, and Union Island. Should Cooper's hawks nest in an area that is subject to project-related disturbances, the reproductive effort of the individual pairs could be disrupted.

Yellow-Breasted Chat

The yellow-breasted chat (*Icteria virens*) is designated by the DFG as a Species of Special Concern. It is a neo-tropical migrant that nests in dense riparian thickets of willow and vine tangles and feeding on insects and fruit. Formerly, it was a fairly common to common breeding bird throughout the Central Valley, but extensive riparian habitat deterioration and elimination, as well as brood parasitism by brown-headed cowbirds (*Molothrus ater*) have diminished its status to local and rare-to-uncommon. Delta riparian habitats, and particularly berm islands, provide suitable habitat for chats. One male yellow-breasted chat singing on a territory was observed during the breeding season on a berm island in the Middle River in the ISDP area (see Appendix A, Figure A-5).

Impacts of the Proposed Project The ISDP is not expected to have any adverse impacts on yellow-breasted chats.

Mitigation Measures None required.

Impacts of Alternatives

1. *Enlargement of Clifton Court Forebay, Construction of Two Intake Structures, Increased Export Capability, and Construction of Permanent Barriers*

The construction of two new intake structures, and the widening of the Middle River downstream from the intake structure to be located at the confluence of Middle River and Victoria Canal, are proposed. The instream islands in the Middle River provide habitat for nesting yellow-breasted chats; these islands may be subjected to erosive forces accelerated by the increased flows generated by project diversions.

White-Faced Ibis

The white-faced ibis (*Plegadis chihi*) is designated by the DFG as a Species of Special Concern. This species requires extensive marshes for its nesting colonies; thus, it has become a very rare and irregular breeder in the Central Valley as marsh habitat has diminished. In the Delta, white-faced ibis are occasionally observed during the winter months foraging for miscellaneous invertebrates in cropland flooded for waterfowl. Although no white-faced ibis were observed during 1993 field surveys, they could utilize agricultural habitats within the ISDP area. No adverse impacts to this species are expected to result from the proposed project.

Aleutian Canada Goose

The Aleutian Canada goose (*Branta canadensis leucopareia*) is designated as endangered by the USFWS. It breeds on islands in Alaska and winters in the Central Valley, primarily west of Modesto in Stanislaus County. In the Delta, migrating Aleutian Canada geese occasionally are observed foraging or roosting in agricultural fields that are flooded for waterfowl. Although no Aleutian Canada geese were observed during 1993 field surveys, they may occasionally utilize the agricultural habitats within the ISDP area.

American White Pelican

The American white pelican (*Pelicanus erythroynchos*) is designated by the DFG as a Species of Special Concern. Formerly, American white pelicans bred in the Central Valley; now only transient or wintering birds are observed flying overhead, or feeding and roosting on lakes or reservoirs. In the Delta, they can be seen roosting on sandbars and in fields that are flooded for waterfowl. A small population of between 6 and 30 non-breeding American white pelicans have been observed during the summer months in the central Delta (Holt pers. observation); however, no American white pelicans were observed during 1993 field surveys in the project area. Although American white pelicans may occasionally utilize the agricultural habitats within the ISDP area, no adverse impacts are expected to result from the proposed project.

Double-Crested Cormorant

The double-crested cormorant (*Phalacrocorax auritus*) is designated by the DFG as a Species of Special Concern. It is considered a very rare breeder in the Central Valley that requires undisturbed nest sites adjacent to water, on ledges or cliffs, or in very tall live or dead trees. In the winter, double-crested cormorants migrate into the Central Valley, probably from breeding colonies in northeastern California and the Great Basin. There are no records of double-crested cormorants nesting in, or near, the ISDP area. Some winter residents and non-breeding birds were observed during the 1993 field surveys roosting or foraging in the ISDP area. The proposed project is not expected to adversely impact this species.

Tricolored Blackbird

The tricolored blackbird (*Agelaius tricolor*) is a federal Category 2 candidate species and is designated by the DFG as a Species of Special Concern. It is nearly endemic to California and is locally common throughout the Central Valley. It is a highly gregarious bird that nests colonially, mainly in dense cattails and tules, but increasingly it is found nesting in blackberry thickets. The proximity of the nesting area to concentrated insect food supplies is important. The lack of concentrated insect sources near suitable nesting sites could account for many observed tricolor nesting failures (Beedy *et al.* 1991). The loss of wetland habitat for nesting and foraging in the Central Valley is a principal factor in the 89 percent decline in population since the 1930s (Beedy *et al.* 1991). Tricolor nesting colonies have not been documented previously in the project area (ECOS 1987, Beedy *et al.* 1991, NDDB 1992). No tricolored blackbirds were observed during 1993 field surveys, although tricolors may utilize the agricultural habitats in the ISDP area during the winter.

Sharp-Shinned Hawk

The sharp-shinned hawk (*Accipiter striatus*) is designated by the DFG as a Species of Special Concern. Although this species does not breed in the Central Valley, it does winter there. No sharp-shinned hawks were observed during 1993 field surveys, but it is likely that a few individuals do use the riparian woodlands within the ISDP area during the winter months.

Osprey

Osprey (*Pandion haliaetus*) are designated by the DFG as a Species of Special Concern. They feed almost exclusively on fish. Formerly, osprey nested throughout the length of the Central Valley but they are now reported as breeding there only on the Sacramento River in Tehama County (Small 1994). Conservation efforts and curtailment of the use of DDT are thought to have halted the decline of this species. One osprey was observed in the ISDP area near Clifton Court Forebay on April 14, 1993. It was not seen again and did not breed in the project area. No adverse impacts to this species are expected to result from the proposed project.

Ferruginous Hawk

The ferruginous hawk (*Buteo regalis*) is a federal Category 2 candidate species. Although this species does not breed in the Central Valley, it is found there during the winter months. It is typically observed foraging in agricultural fields, mainly irrigated pasture and grasslands. However, the ferruginous hawk is not commonly reported in the Sacramento/San Joaquin River Delta, even during winter months. No Ferruginous hawks were observed during 1993 field surveys.

Merlin

The merlin (*Falco columbarius*) is designated by the DFG as a Species of Special Concern. The species does not breed in California, but is present throughout the Central Valley during the winter months. No merlins were observed during field surveys, but the riparian habitats in the ISDP area are potential winter roosting and perching habitat.

American Peregrine Falcon

The American peregrine falcon (*Falco peregrinus anatum*) is listed as endangered by both the USFWS and DFG. It is a rare resident, and uncommon transient and winter visitor to California. Habitat for nesting includes cliffs, ridges, and rocky promontories within hunting range of avian prey, especially waterfowl, shorebirds, and seabirds. In winter peregrines can be found throughout the length of California, including the Central Valley. Conservation efforts and the banning of the pesticide DDT have contributed to a recent upswing in the breeding population. No peregrine falcons were observed during 1993 field surveys; however, peregrines could utilize the ISDP area in winter providing that suitable prey species were available.

Burrowing Owl

The burrowing owl (*Athene cunicularia*) is designated by the DFG as a Species of Special Concern. It often nests in colonies, commonly using ground squirrel burrows for nesting and for cover. It is a resident of the Central Valley, but there is some seasonal movement during fall and winter. Burrowing owls feed mainly on insects but will eat small rodents or reptiles. A recent precipitous decline in burrowing owl populations has been noted in the northern San Joaquin Valley (Small 1994). Individuals have been observed occupying burrows in levees near the project area north of

Tracy and on Robert's Island (Holt pers. observation). Although none were observed during 1993 surveys, burrowing owls could utilize levees and agricultural fields within the ISDP area.

Short-Eared Owl

The short-eared owl (*Asio flammeus*) is designated by the DFG as a Species of Special Concern. It is an uncommon and irregular breeder in the Central Valley. The major known breeding and wintering area in California appears to be Grizzly Island Wildlife Management Area in Solano County (Small 1994). For breeding or roosting short-eared owls require stands of tall grasses in dry or wet lowlands. They hunt over treeless marshes, grasslands, and agricultural lands for small rodents, birds, reptiles, and amphibians. They are present in the Delta during the winter months, foraging or roosting in fields that have suitable food and cover. Although no short-eared owls were observed during 1993 field surveys, individuals could utilize the agricultural fields within the project area during the winter.

Other Raptors

Nest sites of three other raptorial species, the red-tailed hawk (*Buteo jamaicensis*), red-shouldered hawk (*Buteo lineatus*), and great horned owl (*Bubo virginianus*) are included in Appendix A for purposes of interest only. These three species do not have any special status designation; however, they often nest close to species of concern discussed in this report such as the Swainson's hawk. These raptors also compete for many of the same prey items.

REPTILES

Giant Garter Snake

Status

The giant garter snake (*Thamnophis gigas*) is listed as threatened by both the USFWS and DFG. No critical habitat has been designated for this species.

Distribution

The giant garter snake once ranged throughout the wetlands of California's Central Valley from Buena Vista Lake near Bakersfield in Kern County, north to the vicinity of Chico in Butte County (Hansen and Brode 1980). Giant garter snakes appear to have been extirpated from the San Joaquin Valley south of Mendota, Fresno County (Hansen and Brode 1980, Stebbins 1985, Rossman and Stewart 1987). The present known distribution extends from near Chico south to the vicinity of Burrel, Fresno County (DFG 1992).

Habitat Requirements

Habitats occupied by giant garter snakes contain permanent or seasonal water, mud bottoms, and vegetated dirt banks (Fitch 1940, Hansen and Brode 1980). Prior to reclamation, these wetlands probably consisted of freshwater marshes and low gradient streams. In some rice-growing areas, giant garter snakes have adapted well to vegetated, artificial waterways and the rice fields they supply (DFG 1992, Hansen and Brode 1992).

This species appears to be absent from most permanent waters that support predatory game fishes. Introduced bass, sunfish, and catfish compete with giant garter snakes for prey and undoubtedly prey upon the snake as well (Hansen 1988). The species also appears to be absent from natural or artificial waterways that undergo routine mechanical or chemical weed control or compaction of bank soils (Hansen 1988, Hansen and Brode 1992).

Recent field studies have shown that giant garter snakes are associated with aquatic environments that contain the following resources: 1) sufficient water during the active (summer) season to supply food and cover; 2) grassy banks for basking; 3) emergent vegetation for cover during the active season; and 4) high ground or uplands that provide cover and refuge from flood waters during the dormant (winter) season (Hansen 1988, Hansen and Brode 1992).

Reasons For Decline

Factors leading to the decline of the giant garter snake include the fragmentation and loss of valley wetland habitats to agriculture, urbanization, and flood control (Hansen and Brode 1980). Existing habitats continue to be degraded by toxic chemicals associated with agriculture, industry, and urban

runoff. Proposed urban developments, including development of the North Natomas region near Sacramento, threaten several remaining giant garter snake populations (DFG 1992). Other impacts of urbanization include pollution, destruction of food resources, and removal by collectors (DFG 1992).

Predatory fish that were introduced throughout the Central Valley's system of artificial waterways have reduced the suitability of nearly all permanent waters for this species by preying upon, and competing with, giant garter snakes. The widely introduced bullfrog (*Rana catesbeiana*) also preys upon this species (Treanor 1983).

Potential For Occurrence in the ISDP Area

Historically, giant garter snakes occurred in both the South and North Delta regions (Hansen and Brode 1980, Hansen 1988, NDDB 1992). Individuals have been observed in the North Delta region at North Stone Lake, Beach Lake, and near Locke (ECOS 1990b). The species also was recorded from near the Antioch Bridge west of the ISDP area (NDDB 1992). Other documented occurrences are distributed around the periphery of the North and East Delta in habitats similar to those in the ISDP area (ECOS 1990b).

Although the major permanent waterways of the Delta are apparently unsuitable for giant garter snakes, small backwater sloughs and toe drains support small numbers of giant garter snakes (Hansen 1988).

Field surveys were conducted for the giant garter snake along the lower Feather River during the spring and summer of 1992 (Hansen 1992). Although no garter snakes were found suitable habitat exists outside of the main river channel in sloughs and backwaters. Proposed changes in operations at Oroville Dam would not impact snakes occupying these habitats.

Survey Methodology

Potential supporting habitats of the giant garter snake were located by searching the ISDP area from roadways, on foot, and by boat. During initial reconnaissance surveys in 1993, USGS 7.5-minute topographic maps, project prints, and written descriptions supplied by DWR were consulted in planning and conducting field work. Topographic maps were used to mark areas of potentially suitable habitat for later field surveys.

Field surveys for the giant garter snake included walking, wading, and boating along canals, river channels, and marshes. Binoculars were used to search potential basking spots and to identify snakes from a distance. Giant garter snakes were also sought beneath surface objects, especially boards and other debris deposited by floodwaters. Although peak surface activity occurs during the spring (April and May), above-ground activities are dependent upon mild weather. Field surveys were timed to coincide with favorable weather conditions for optimum results. Repeat visits were made to promising sites. During all phases of field work, roadways were searched for living and dead giant garter snakes.

DFG prepared written survey protocols for the giant garter snake in 1993 (DFG 1993b). These were implemented for this project wherever possible. It was not necessary to alter the methodologies presented above to accommodate new protocols, except that the number of visits to sites supporting potential giant garter snake habitat was less than the 10 required by the 1993 survey protocols. This was due to prior contract arrangements and lack of permission to access certain portions of the project area.

In 1995, trapping surveys were conducted by George Hansen in the habitats deemed most suitable for giant garter snakes in the ISDP area (Figures V-1 and V-2). Floating funnel traps were set and checked daily in suitable habitats. Giant garter snakes were sought during April, May, and June, 1995, by walking, wading, boating, and live-trapping along Paradise Cut, Salmon Slough, and Tom Paine Slough. Surveys were conducted on April 22, May 1 - 6 inclusive, May 16 - 25, inclusive, and June 3, 8, and 20, 1995. Binoculars were used to search potential basking spots and to identify snakes at a distance. Floating wire mesh funnel traps were set along all three sloughs (Figures 1 and 2) where habitat looked especially promising for giant garter snakes. During May and June, 1995, 20 traps were set and checked daily for periods of several days at a time. These traps were then moved to new locations and again checked daily for several days. Trapping was conducted for 10 days along each slough for a total trapping effort of 360 trap-days.

In 1995, in order to meet the DFG (1993) survey requirements, our surveys were: 1) conducted within the spring/summer peak giant garter snake activity period, 2) conducted with a minimum of 10 visits per suitable site (or until giant garter snakes were observed), and 3) conducted with a combination of walking/boating surveys coupled with a trapping program.

Extensive handling of specimens of any species was avoided. A valid federal Fish and Wildlife permit (PRT-789252), Memorandum of Understanding with DFG, and a valid California fishing license are required when handling or trapping giant garter snakes. All were in Mr. Hansen's possession during surveys. No other permits or licenses were required to perform the tasks described above.

Survey Results

Giant Garter Snake Individuals No giant garter snakes were observed within the ISDP area during 1993 field surveys. However, the limited time available for field surveys, and restricted access to portions of the ISDP area such as Victoria Island, made it impossible to rule out their presence in the vegetated waterways, uplands, and other potential supporting habitats occurring within the project area.

Giant garter snakes were not detected during 1995 surveys despite adherence to DFG's survey protocols. However, giant garter snakes may yet occur on the ISDP area. DFG's giant garter snake survey protocols were designed to provide guidance to surveyors and increase their chances of encountering any giant garter snakes present, but they do not guarantee success. Failure to trap or observe this secretive species does not represent proof of its absence. Because giant garter snakes may yet be present along ISDP area waterways, and because they may enter the area at any time (such as from the eastern periphery of the Delta), impacts from the ISDP could hypothetically affect this species in the project area or undetected local populations outside the immediate area.

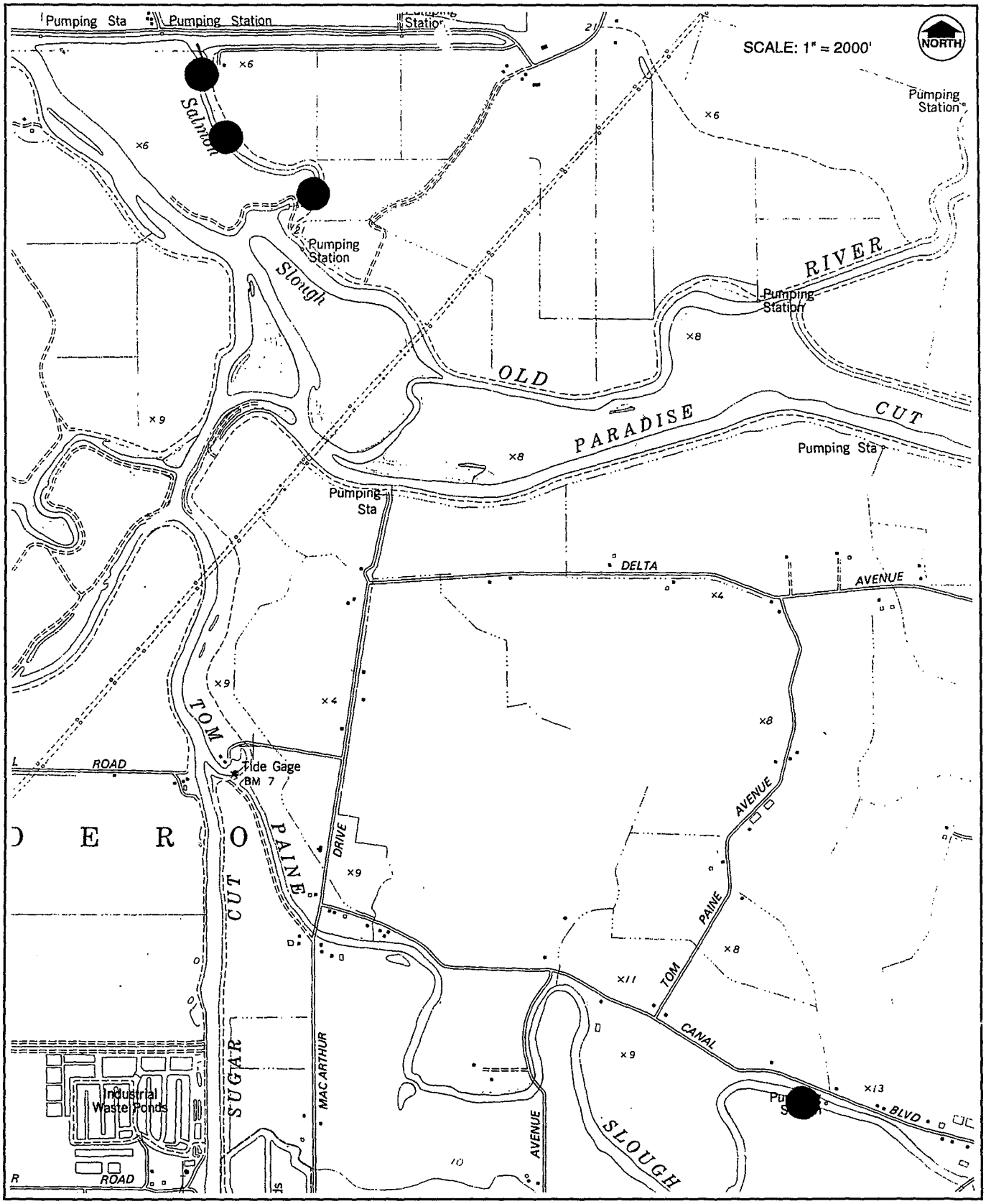

Figure V-1. Trapping Locations for the Giant Garter Snake, 1995
(Source: Lathrop USGS 7.5 minute topographic quadrangle)

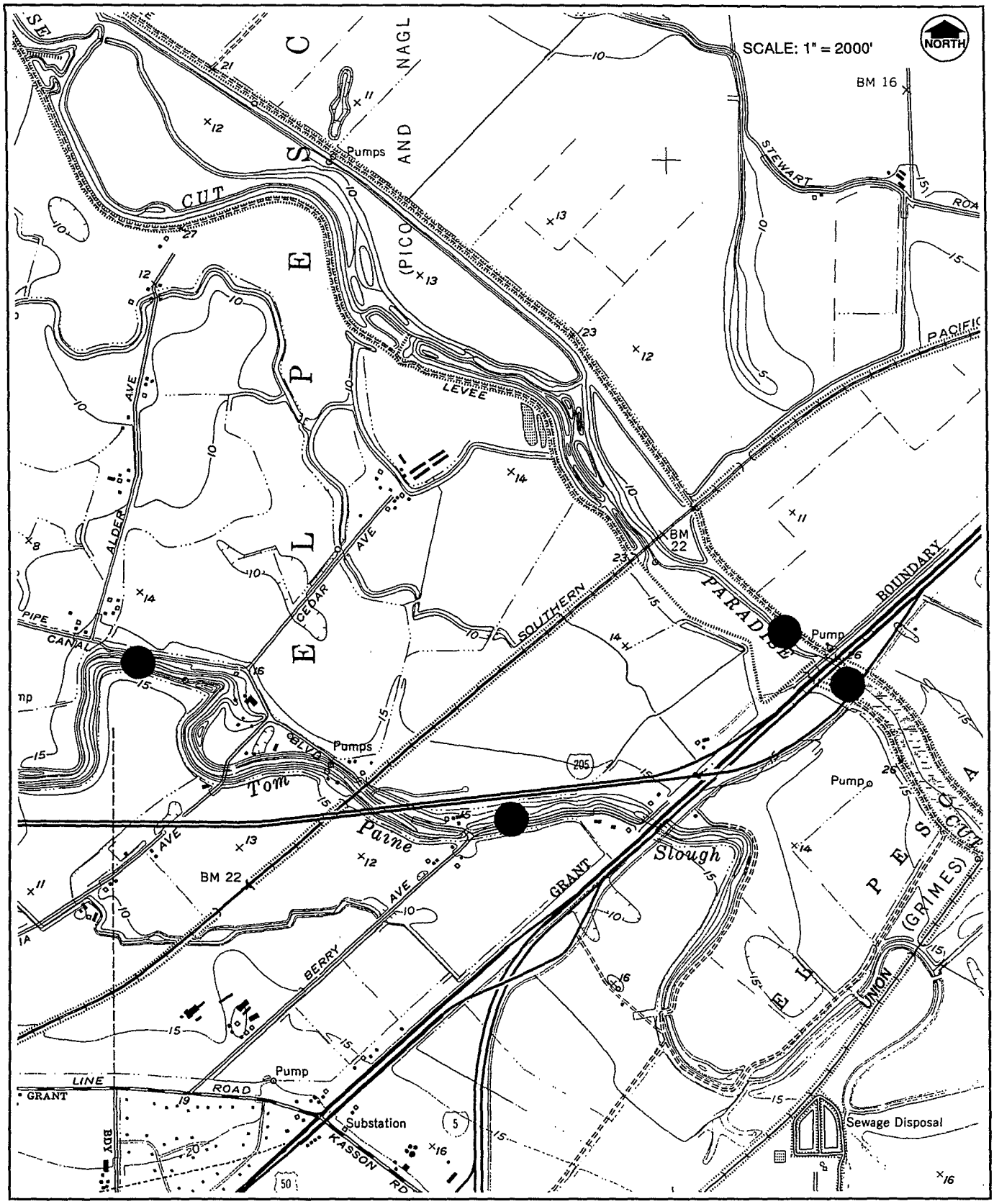

Figure V-2. Trapping Locations for the Giant Garter Snake, 1995
(Source: Union Island USGS 7.5 minute topographic quadrangle)

Giant Garter Snake Habitat Suitable habitat for this species was found along Tom Paine Slough north and south of Interstate 5 and Interstate 205, and along Salmon Slough north of Old River. Due to spring flooding along Paradise Cut north and south of Interstate 5 in 1995, this habitat appeared only marginally suitable for giant garter snakes during our 1995 survey period; however, later in the season as the water recedes, or during future years, this area would once again possess favrable habitat values for the giant garter snake.

Victoria Island, including the cultivated sites proposed for dredge spoil storage areas, contains marginal to suitable giant garter snakes habitat. The most favorable habitat occurs along the agricultural ditches around the perimeter of the island and along the interior ditches, especially those along Highway 4 and along the interior toe drains of Victoria Island levees.

Wetland habitat of unknown value to giant garter snakes occurs along the banks and islands of the ISDP area channels. Although no giant garter snakes were observed here, survey efforts were not sufficient to rule out their presence.

General Impacts

Based on available information regarding the distribution, habitat requirements, and biology of the giant garter snake, and the knowledge of the species gained from over 20 years of field surveys by George Hansen, it is our opinion that it is unlikely that the ISDP area supports a self-sustaining breeding population of giant garter snakes. However, because individuals may occasionally disperse along the waterways within the south Delta region, especially during flooding, and the fact that giant garter snakes may be present in small numbers in the general project vicinity, potential impacts are discussed in this section. While these impacts do not represent significant threats to the remaining giant garter snake populations in the Central Valley, they could represent a significant impact to individual snakes.

Because undetected giant garter snakes may yet be present along ISDP waterways, this project could adversely impact undetected local populations. Impacts could result from:

- Direct mortality,
- Permanent loss of occupied habitat or unoccupied suitable habitat,
- Temporary loss of habitat that may result in increased mortality or lowered reproductive success, or
- Avoidance by wildlife of biologically important habitats for substantial periods that may increase mortality or lower reproductive success.

Giant garter snakes could suffer losses of individuals and supporting habitat resulting from project-related actions. Potential impacts to giant garter snakes include: 1) the death or injury to individual snakes resulting from construction activities, 2) habitat loss resulting from dredging, grading or placement of dredge spoils within such potential habitats as landward irrigation ditches, vegetated channel islands, and channel banks along Old River between Highway 4 and Victoria Canal, along Victoria and North canals, and in Middle River between North Victoria Canal and Trapper Slough,

3) changes in the prey base resulting from changes in ISDP water quality, or 4) changes in vegetation and inundation of artificial structures (i.e., riprap) resulting from changes in water levels.

Specific project actions and their potential impacts upon giant garter snakes are discussed next.

Impacts of the Proposed Project

The ISDP is composed of five components, each of which may affect giant garter snakes if they are present in the local area. Although several attempts have been made since 1987 to determine whether giant garter snakes occur within the ISDP area, its status remains unknown. The following section breaks down the ISDP into its components and discusses the potential impacts of each component.

Component 1: Construct and operate a new intake structure at the SWP Clifton Court Forebay

Construction of a new intake structure could increase the possibility of accidental death or injury to any giant garter snakes that may occupy the immediate construction vicinity or that may occur along access routes used by construction personnel and equipment. Giant garter snakes may be killed or injured if they are drawn by flowing water into the new intake structures during operation. Increasing export capability at Clifton Court Forebay may impact giant garter snakes if increased water velocities in the channels near these intake structures cause changes in bank, aquatic, and emergent vegetation utilized by giant garter snakes.

Component 2: Perform channel dredging along a reach of Old River just north of Clifton Court Forebay

Channel dredging along Old River could alter vegetated wetland habitats presently found on channel islands, point bars, and banks resulting in the loss of potentially suitable habitat.

Placement of dredge spoils upon agricultural lands on Victoria Island could affect giant garter snakes that may occupy the agricultural ditches and drains presently found on the island. If spoils are placed within these agricultural ditches, giant garter snakes could be buried and supporting habitat would be lost. If water decanted from spoils is of poor quality (or toxic) and is drained from the spoil ponds into the existing agricultural ditch system, giant garter snakes or their supporting prey items, as well as supporting vegetation for both could be lost. If spoil material is placed upon the landward sides of existing levees, suitable habitats along toe drains would be lost. Construction vehicles carrying spoils to the storage sites may travel along roads near existing vegetated ditches, increasing human disturbance and the risk of accidental injury or death to any giant garter snakes present.

Component 3: Construct and operate a barrier seasonally in both the spring and fall to improve fishery conditions for salmon migrating along the San Joaquin River

Construction of a barrier could increase the possibility of accidental death or injury to any giant garter snakes that may occupy the immediate construction vicinity or that may occur along access routes used by construction personnel and equipment. Changes in water levels within the ISDP channels that would result from operation of this barrier could alter channel vegetation and existing

habitats in ways detrimental to any giant garter snakes that may yet occupy the Old River, Middle River, Tom Paine Slough, or any wetland habitats associated with these channels.

Component 4: Construct and operate three flow control structures to improve existing water level and circulation patterns for agricultural users in the south Delta

As with Component 3, construction of flow control structures could increase the possibility of accidental death or injury to any giant garter snakes that may occupy the immediate construction vicinity or that may occur along access routes used by construction personnel and equipment. Changes in water levels within the ISDP channels that result from operation of this barrier could alter channel vegetation and existing habitats in ways detrimental to any giant garter snakes that may yet occupy the Old River, Middle River, Tom Paine Slough, or any wetland habitats associated with these channels.

Component 5: Increase diversions into Clifton Court Forebay

Since giant garter snakes may yet occupy wetland habitats within the ISDP area, they may be adversely affected by increased diversions into Clifton Court Forebay if these actions alter existing wetland habitats or result in the loss of these habitats. For instance, channel islands, point bars, or bank vegetation could be subject to increased scouring by increased water velocities that would be generated along project area waterways during increased diversions.

Increased diversions into Clifton Court Forebay could also threaten giant garter snakes with physical injury if individuals are present near the intake structures during operations. Although screening these structures could save snakes from being pulled into the pumps, screen design may not prevent giant garter snakes from being trapped against the screens by flowing water, resulting in death (by drowning) or injury to any snake that swims near the intake during operation.

Impacts of Alternatives

1. *Enlargement of Clifton Court Forebay, Construction of Two Intake Structures, Increased Export Capability, and Construction of Permanent Barriers*

Since giant garter snakes may yet occupy suitable habitats within the ISDP area, and since potentially suitable giant garter snake habitat occurs within the proposed northern Victoria Island forebay enlargement and along the vegetated river channels, channel islands, and landward toe drains throughout the project area, this alternative may adversely impact giant garter snakes.

Forebay enlargement - Existing suitable habitats within and near vegetated agricultural drains and canals on northern Victoria Island would be inundated by the new forebay and replaced with an unsuitable shallow lake with gently sloping shores. If giant garter snakes are present, snakes may be injured or killed during construction, permanently displaced by flooding of the new forebay, disturbed temporarily by human activities along suitable canals and drains near the new forebay, or forced to vacate or avoid existing suitable habitats outside the new forebay due to increased human (or predator) presence relating to the forebay.

If realignment of Highway 4 is required, relocation of its adjacent existing drainage ditches would represent a temporary loss of potential supporting habitat. The construction of the new levee required by this alternative would also require filling of Victoria Island ditches, which would represent a loss of habitat. Both actions could result in death, injury, or displacement of any giant garter snakes that may be present.

If borrow material is required for construction, threats to giant garter snakes could include the loss of habitat (agricultural ditches within the borrow area) and any giant garter snakes that may be present within the construction area, or along access routes used by project-related vehicles. Snakes may be killed, injured or displaced by construction activities.

Construction of two intake structures and increased export capability - Construction of two intake structures could increase the possibility of accidental death or injury to any giant garter snakes that may occupy the immediate construction vicinity or that may occur along access routes used by construction personnel and equipment. Giant garter snakes may be killed or injured if drawn into the new intake structures during operation. Increasing export capability may impact giant garter snakes if increased water velocities in the vicinities of these intake structures cause changes in bank, aquatic, and emergent vegetation within project area waterways.

Construction of permanent barriers - Construction of permanent barriers could increase the possibility of accidental death or injury to any giant garter snakes that may occupy the immediate construction vicinity or that may occur along access routes used by construction personnel and equipment. Changes in water management within the ISDP channels resulting from operation of these permanent barriers could alter vegetation and existing habitats in ways detrimental to any giant garter snakes that may yet occupy Old River, Middle River, Tom Paine Slough, or any dead end wetlands associated with these channels.

2. *Reduction of CVP/SWP Exports and Management or Reduction of Demand for SWP Water*

Giant garter snakes occupying habitats outside the ISDP area may be adversely impacted by reductions in water deliveries to farms within the San Joaquin Valley. Suitable habitats known to support (or to have supported) giant garter snakes within the Grasslands Water District of Fresno, Merced, and Madera counties exist primarily due to the presence of agricultural wastewater. Habitat losses that may result from reductions in the amount of water available to Grasslands area farms, wildlife areas, or wildlife refuges would be considered significant.

3. *Increased flows on the San Joaquin River, modification of CVP/SWP exports, channel dredging for agricultural diversions, extending and/or consolidation of diversions, screening of diversions, improvements to the Skinner fish salvage facility, and predation control*

Since giant garter snakes may yet occupy wetland habitats within the ISDP area, they may be adversely affected by channel dredging or extending diversions if these actions alter existing wetland habitats or result in the loss of these habitats within the ISDP area. For example, channel island, point bar, or bank vegetation could undergo increased scouring by increased water velocities that would be generated along project area waterways during extended diversions. Modifications of CVP/SWP exports could affect giant garter snake habitats outside the ISDP area, such as wetlands

presently existing within the Grasslands region of the central San Joaquin Valley which depend upon agricultural wastewater.

If an overland open channel system is constructed, giant garter snakes that may occupy existing agricultural ditches may be killed, injured, or displaced during construction, or may lose habitat along existing landward levee toe drains as the new channels are constructed.

Although screening diversions could save snakes from being drawn into intake structures, screen design may not prevent giant garter snakes from being trapped against the screens by flowing water, resulting in death or injury to any snake that swims near the intake during operation.

4. *ISDP with an additional Clifton Court Forebay intake at Italian Slough*

Potential impacts to giant garter snakes that may result from implementation of this alternative are similar to those of the Proposed Project (ISDP) with the addition of the following: 1) intake operation may cause permanent or temporary loss of potential supporting habitat of giant garter snakes located along the upstream (western) reaches of Italian Slough due to fluctuations in water levels, 2) habitat within the construction area, especially between the two required earthen "plugs", would be temporarily lost during construction, and 3) any giant garter snakes that may be present within Italian Slough would be at risk of being drawn into the operating intake structure.

5. *ISDP without the northern intake, and with an expanded existing intake*

Potential impacts to giant garter snakes that may result from implementation of this alternative are similar to those of the Proposed Project (ISDP) with the addition of the following: 1) loss of vegetation and other supporting habitat may result from increased water velocities and fluctuation in water levels along waterways near the expanded intake, and 2) giant garter snakes that may be present near the expanded intake would be at greater risk of being drawn into the intake structure as water velocities near the structure increase during operation.

6. *ISDP without the northern intake, and with an intake at Italian Slough*

Potential impacts to giant garter snakes that may result from implementation of this alternative are similar to those of the Proposed Project (ISDP) with the addition of the following: permanent or temporary loss of potential supporting habitat of giant garter snakes located along the upstream (western) reaches of Italian Slough may occur due to fluctuations in Italian Slough water levels during intake operation. Any giant garter snakes that may be present within Italian Slough would be at risk of being drawn into the operating intake structure.

7. *No Action (maintain existing conditions)*

If giant garter snakes have declined or are declining within the south Delta due to past and present management practices, these declines would continue.

8. *No action (maintain conditions as they would exist in the future)*

If giant garter snakes have declined or are declining within the south Delta due to past and present management practices, these declines would continue.

If future competition for water results in reduced deliveries to farms, giant garter snakes occupying habitats outside the ISDP area may be adversely impacted. Suitable habitats known to support (or to have supported) giant garter snakes within the Grasslands Water District service area of Fresno, Merced, and Madera counties exist primarily due to the presence of agricultural wastewater. Habitat losses that may result from reductions in the amount of water available to Grasslands area farms, wildlife areas, or wildlife refuges would be considered significant.

Mitigation Measures

Because no giant garter snakes have been located in the ISDP area mitigation measures are general in nature and focus on construction protocols. The following measures would reduce potentially adverse impacts.

- Inform construction workers and truck drivers of the area's sensitivity for certain wildlife. Any snakes or turtles that are observed crossing roadways should be avoided. Drivers should be restricted to speeds of 15 mph or less when traveling along roadways adjacent to drainage ditches or toe drains.

- If any dead snakes are observed along roadways drivers should contact the construction foreman who, in turn, should contact the local DFG office. A representative from DFG should visit the site to make a positive identification of the species.

- Spoil disposal operations on Victoria Island should avoid agricultural drains around the perimeter of the island and interior ditches, especially along drains parallel to Highway 4. This includes truck traffic and heavy equipment operations.

DFG compiled draft mitigation guidelines for the giant garter snake (DFG 1994b). These guidelines provide information on mitigation required for short-term habitat loss, long-term habitat loss, and maintenance of giant garter snake habitat. A summary of relevant items from these mitigation guidelines is provided below:

Maintenance of Giant Garter Snake Populations and Habitat - Short-Term Habitat Loss

A. Protection of Giant Garter Snake Populations During Maintenance and Operation of Agricultural Canals and Drains

1. Excavate from only one side of the canal during a given year and avoid excavating the banks above the water line. One side of the canal will be left undisturbed indefinitely (the preferred side would be the west or north side).

2. During summer (May 1 to October 1), place the spoils in a designated location and remove or flatten out spoils soon after placement. During winter it may be necessary to transport spoils to an off-site designated area.

3. Leave the vegetation on the levees and sides of the canals undisturbed, except that maintenance roads may be mowed. Mowing shall leave a minimum 6-inch stubble to avoid injury to giant garter snakes.

4. Restrict automobile traffic along the canals to maintenance or other official vehicles.

Western Pond Turtle

Status

The western pond turtle (*Clemmys marmorata*) includes two subspecies, the northwestern pond turtle (*Clemmys marmorata marmorata*) and the southwestern pond turtle (*Clemmys marmorata pallida*). Both subspecies are designated as Category 2 candidates for federal listing and as Species of Special Concern by DFG. No critical habitat has been designated for this species.

Distribution

The western pond turtle occurs in suitable aquatic habitats throughout California west of the Sierra crest and in parts of Oregon and Washington (Stebbins 1985, DFG 1988). The northwestern subspecies is found generally north of San Francisco Bay, while the southwestern subspecies is found south of San Francisco Bay. The two subspecies may intergrade throughout the Delta and San Joaquin Valley (Stebbins 1985), or intergrades may be restricted to the Delta region with San Joaquin Valley populations represented by the southwestern pond turtle (USFWS 1992).

Habitat Requirements

Western pond turtles normally are found near a wide variety of wetlands, including ponds, marshes, lakes, streams, and irrigation ditches (Stebbins 1985, DFG 1988). Suitable habitats usually are well-vegetated and contain exposed logs, rocks, or other basking sites from which turtles can easily escape into the water when disturbed (Stebbins 1985). Egg-laying may occur along sandy wetland margins or at upland locations as far as 1,300 feet from water (Holland and Bury 1992).

The species generally is associated with permanent or nearly permanent wetlands in a wide variety of environments below 6,000 feet (DFG 1988). Basking sites are required and nests may be located as far as 0.5 kilometer from water (NDDB 1992). Hatchlings and juveniles apparently require a more specialized aquatic habitat than do adults (USFWS 1992).

Reasons For Decline

Commercial collecting, wetland and upland habitat loss, and introduced predators have all been implicated in the decline of the western pond turtle (Brode pers. comm., Holland and Bury 1992, USFWS 1992). Less than 10 percent of wetlands historically found throughout the species' range in California persist today (Jennings pers. comm., USFWS 1992).

Survey Methodology

Potential supporting habitats were located by searching the ISDP area from roadways, on foot, and by boat. During initial reconnaissance surveys, USGS 7.5-minute topographic maps were used to mark potentially suitable habitats for later field surveys.

Field surveys included walking, wading, and boating along canals, river channels, and marshes. Binoculars were used to search potential basking spots and to locate turtles from a distance. Repeat visits were made to promising sites during the 1993 field season. Also, locations of basking turtles were mapped during field surveys for other species.

Survey Results

Western pond turtles were observed at scattered locations throughout the waterways of the ISDP area (see Appendix A, Figures A-3, A-4, A-6, A-11, A-12, A-14, A-16, A-17, A-18, A-19, A-20, A-21, and A-22) and appear to be widespread throughout the permanent waterways of the Delta (ECOS 1987, 1990a,b; DWR 1992). During prior studies in the south Delta region pond turtles were observed basking upon emergent objects at Salmon Slough, Old River, and Middle River (ECOS 1990a). They probably inhabit canals and ditches in this region as well.

No western pond turtles were observed during prior field surveys along the Feather River (Hansen 1992); however, they are probably present in the main channel. Changes in operations at Oroville Dam, and the resulting changes in water levels in the lower Feather River, would not adversely impact this species.

General Impacts

Because western pond turtles occur along ISDP waterways, the project could affect individual turtles or local populations. Impacts may result from the following:

- Direct mortality,
- Permanent loss of occupied habitat or unoccupied suitable habitat,
- Temporary loss of habitat that may result in increased mortality or lowered reproductive success, or
- Avoidance by wildlife of biologically important habitats for substantial periods that may increase mortality or lower reproductive success.

Western pond turtles could suffer losses of individuals and supporting habitat resulting from project-related actions. Potential impacts to western pond turtles include: 1) the death or injury to individual turtles or their nests resulting from construction activities, 2) habitat loss resulting from dredging, grading, or placement of dredge spoils within such potential habitats as landward irrigation ditches, vegetated channel islands, and channel banks along Old River between Highway 4 and Victoria Canal, along Victoria and North canals, and in Middle River between North Victoria Canal and Trapper Slough, 3) changes in prey/forage base resulting from changes in ISDP water quality, or 4) changes in vegetation and inundation of artificial structures that provide basking habitat resulting from changes in water levels.

During late spring and early summer, gravid female turtles leave the water to excavate nests and lay their eggs in terrestrial habitats. Since the nests may be located up to 1,300 feet from water, these turtles are vulnerable to being run over by construction equipment, may become disoriented by altered habitat, or can be exposed to increased chances of predation or accidents while moving about the construction area. Turtle eggs laid in construction areas may also be destroyed by routine construction activities such as grading, soil compaction, burial under spoil material, or being run over and crushed by construction equipment.

Turtle basking sites such as emergent pipes, culverts, logs, wing dams or jetties, low beaches and channel islands also may be lost to changes in water levels, especially to inundation if water levels rise. Pond turtles excavate nests and bury their eggs on low beaches and probably on channel islands as well. These nests could be destroyed if inundated by summertime increases in water levels, or nesting areas could be lost to rising water prior to nesting.

Pond turtles were observed most frequently and in greatest numbers in areas where ample basking sites and sheltering vegetation were available, and where human disturbance, especially boaters, was minimal. Human activity within construction areas could displace turtles as they flee construction related disturbances. This may force turtles away from once favorable supporting habitat within construction areas into areas of concentrated human activity and increased danger.

Indirect impacts include the reduction in numbers of adult western pond turtles and the disturbance to nesting sites which could result in decreased reproduction. This could induce population declines of unknown duration.

Impacts of the Proposed Project

The ISDP is composed of five components, each of which could affect western pond turtles. The following section breaks down the ISDP into its components and discusses the potential impacts of each component.

Component 1: Construct and operate a new intake structure at the SWP Clifton Court Forebay

Construction of a new intake structure could increase the possibility of accidental death or injury to any western pond turtles that may occupy the immediate construction vicinity or that may occur along access routes used by construction personnel and equipment. Pond turtles may be killed or injured if they are drawn by flowing water into the new intake structures during operation. Increasing export capability may impact pond turtles if increased water velocities in the vicinity of

these intake structures causes changes in bank, aquatic, and emergent vegetation used by turtles within ISDP waterways.

Component 2: Perform channel dredging along a reach of Old River just north of Clifton Court Forebay

Channel dredging along Old River could result in death or injury to western pond turtles occupying this area, and may alter wetland habitats presently found on channel islands, point bars, and banks. Pond turtles that occupy these habitats may also be affected by increased human presence during dredging operations.

Placement of dredge spoils on Victoria Island could affect any pond turtles that occupy agricultural ditches and drains presently found on the island. If spoils are placed within these agricultural ditches, individual turtles could be buried. At the very least, habitat would be lost. If water decanted from spoils is of poor quality (or toxic) and is drained from the spoil areas into the existing agricultural ditch system, western pond turtles or their supporting prey, forage, and vegetational habitat could be lost. If spoil materials are placed upon the landward sides of existing levees, nesting sites and suitable habitats along toe drains could be lost. Construction vehicles carrying spoils to the storage sites may travel along roads near existing vegetated ditches, increasing human disturbance and risk of accidental injury or death to any western pond turtles or eggs present.

Component 3: Construct and operate a barrier seasonally in both the spring and fall to improve fishery conditions for salmon migrating along the San Joaquin River

Construction of a barrier could increase the possibility of accidental death or injury to any pond turtles that occupy the immediate construction vicinity or that occur along access routes used by construction personnel and equipment. Changes in water management within the ISDP area channels resulting from operation of this barrier could alter channel vegetation and existing habitats in ways detrimental to pond turtles that occupy Old River, Middle River, Tom Paine Slough, or other wetland habitats associated with these channels.

Component 4: Construct and operate three flow control structures to improve existing water level and circulation patterns for agricultural users in the south Delta

As with Component 4 above, construction of flow control structures could increase the possibility of accidental death or injury to any western pond turtles that occupy the immediate construction vicinity or that may occur along access routes used by construction personnel and equipment. Changes in water management within the ISDP area channels resulting from operation of this barrier could alter channel vegetation and existing habitats in ways detrimental to any turtles that occupy Old River, Middle River, Tom Paine Slough, or other wetland habitats associated with these channels.

Component 5: Increase diversions into Clifton Court Forebay

Since western pond turtles occupy wetland habitats within the ISDP area, they may be adversely affected by increased diversions into Clifton Court Forebay if these actions alter existing wetland habitats or result in the loss of these habitats within the ISDP area. For instance, nesting and basking sites and vegetation on channel islands, point bars, or banks could be subject to increased

scouring by increased water velocities that would be generated along project waterways during increased diversions.

Increased diversions into Clifton Court Forebay could also threaten pond turtles with physical injury if they are present near the intake structures during operation. Although screening these structures could save turtles from being pulled into pumps, screen design may not prevent turtles from being trapped against the screens by flowing water, possibly resulting in death or injury to any turtle that swims near the intake during operation.

Impacts of Alternatives

1. *Enlargement of Clifton Court Forebay, construction of two intake structures, increased export capability, and construction of permanent barriers*

Since western pond turtles occupy suitable habitats within the ISDP area, and since potentially suitable pond turtle habitat occurs within the proposed northern Victoria Island forebay enlargement and along the vegetated river channels, channel islands, and landward toe drains throughout the project area, this action may adversely impact this species.

Forebay enlargement - Existing suitable habitats within and near vegetated agricultural drains and canals on northern Victoria Island would be inundated by the new forebay and replaced with an unsuitable shallow lake with gently sloping shores. Western pond turtles that are present may be injured or killed during construction, permanently displaced by construction of the new forebay, disturbed temporarily by human activities along suitable canals and drains near the new forebay during construction, or forced to vacate or avoid existing suitable habitats outside the new forebay due to increased human (or predator) presence.

If realignment of Highway 4 is required, relocation of its adjacent existing drainage ditches would represent a temporary loss of potential supporting habitat. The construction of the new levee required by this alternative would also require filling of Victoria Island ditches and would represent a loss of habitat. Both actions could result in death, injury, or displacement of pond turtles.

If borrow material is required for construction, threats to pond turtles could include the loss of habitat (i.e., agricultural ditches within the borrow area). Western pond turtles that may be present within the construction area or along access routes used by project-related vehicles may be killed, injured, or displaced by construction activities.

Construction of two intake structures and increased export capability - Construction of two intake structures could increase the possibility of accidental death or injury to any western pond turtles that occupy the immediate construction vicinity or that occur along access routes used by construction personnel and equipment. Western pond turtles may be killed or injured if drawn into the new intake structures during operation. Increasing export capability may impact pond turtles if increased water velocities in the vicinity of these intake structures cause changes in bank, aquatic, and emergent vegetation within project waterways.

Construction of permanent barriers - Construction of permanent barriers could increase the possibility of accidental death or injury to any western pond turtles that occupy the immediate

construction vicinity or that occur along access routes used by construction personnel and equipment. Changes in water management within the ISDP area channels resulting from operation of these permanent barriers could alter vegetation and existing habitats in ways detrimental to pond turtles that occupy the Old River, Middle River, Tom Paine Slough, or other wetland habitats associated with these channels.

2. *Reduction of CVP/SWP Exports and Management or Reduction of Demand for SWP Water*

Western pond turtles occupying habitats outside the ISDP area may be adversely impacted by reductions in water deliveries to farms within the San Joaquin Valley. Suitable habitats known to support (or to have supported) pond turtles within the Grasslands Water District service area of Fresno, Merced, and Madera counties exist primarily due to the presence of agricultural wastewater. Habitat losses that may result from reductions in the amount of water available to Grasslands area farms, wildlife areas, or wildlife refuges would be considered significant.

3. *Increased flows on the San Joaquin River, modification of CVP/SWP exports, channel dredging for agricultural diversions, extending and/or consolidation of diversions, screening of diversions, improvements to the Skinner fish salvage facility, and predation control*

Since western pond turtles occupy wetland habitats within the ISDP area, they may be adversely affected by channel dredging or extending diversions if these actions alter existing wetland habitats or result in the loss of these habitats within the ISDP area. For example, channel island, point bar, or bank vegetation could be subject to increased scouring by increased water velocities that would be generated along project waterways during extended diversions. Modifications of CVP/SWP exports could affect western pond turtle habitats outside the ISDP area, such as wetlands presently existing within the Grasslands region of the central San Joaquin Valley that depend upon agricultural wastewater.

Although screening diversions could save turtles from being pulled into pumps, screen design may not prevent turtles from being trapped against the screens by flowing water, resulting in death or injury to any turtle that swims near the intake during operation.

4. *ISDP with an additional Clifton Court Forebay intake at Italian Slough*

Potential impacts to western pond turtles that may result from implementation of this alternative are similar to those of the proposed project, except that 1) permanent or temporary losses of potential supporting habitat of western pond turtles located along the upstream (western) reaches of Italian Slough may occur due to fluctuations in Italian Slough water levels during intake operation, and 2) any turtles that may be present within Italian Slough would be at risk of being drawn into the operating intake structure.

5. *ISDP without the northern intake, and with an expanded existing intake*

Potential impacts to pond turtles that may result from implementation of this alternative are similar to those of the Proposed Project, except that 1) loss of vegetation and other habitat may result from increased water velocities and fluctuations in water levels along nearby waterways may be increased by expanding the existing intake, and 2) any pond turtles present within ISDP waterways near the expanded intake would be at greater risk of being pulled into the operating intake structure as water velocities near the structure increase.

6. *ISDP without the northern intake, and with an intake at Italian Slough*

Potential impacts to pond turtles that may result from implementation of this alternative are similar to those of the Proposed Project, except that permanent or temporary losses of potential supporting habitat located along the upstream (western) reaches of Italian Slough may occur due to fluctuations in Italian Slough water levels during intake operation. Any western pond turtles that are present within Italian Slough would be at risk of being drawn into the operating intake structure.

7. *No Action (maintain existing conditions)*

If populations of western pond turtles have declined or are declining within the south Delta due to past and present management, these declines would continue.

8. *No Action (maintain conditions as they would exist in the future)*

If populations of western pond turtles have declined or are declining within the south Delta due to past and present management, these declines would continue.

If future competition for water results in reduced deliveries to farms, pond turtles occupying agricultural waterways outside the ISDP area may be adversely impacted. Suitable habitats known to support western pond turtles within the Grasslands service area of Fresno, Merced, and Madera counties exist primarily due to the presence of agricultural wastewater. Habitat losses that may result from reductions in the amount of water available to Grasslands area farms, wildlife areas, or wildlife refuges would be considered significant.

Mitigation Measures

Guidelines prepared by DFG to mitigate short-term loss for the giant garter snake should also benefit the western pond turtle. These draft mitigation guidelines provide information on mitigation required for short-term wetland habitat loss, long-term habitat loss, and maintenance of wetland habitats (see mitigation measures for giant garter snake). Reducing human activity in potential nesting areas during the May-July nesting period may eliminate some losses of adults adult turtles. Avoiding raising water levels during the nesting-incubation period (June-September) should prevent inundation of eggs deposited on low beaches or islands. Also, abstaining from dredging activities during the winter months would protect hibernating turtles.

INVERTEBRATES

Valley Elderberry Longhorn Beetle

Status

The valley elderberry longhorn beetle (*Desmocerus californicus dimorphus*) (VELB) was listed by the USFWS as threatened with critical habitat on August 10, 1980 (USFWS 1991b).

Distribution

Prior to its listing in 1980, the species was reported only from Putah Creek (Yolo and Solano counties), the Merced River (Merced County), and the American River (Sacramento County). The type-locality was reported as "Sacramento, California.". The range was described as the "lower Sacramento Valley to upper San Joaquin Valley (Linsley and Chemsak 1972).

According to NDDB (1992), the reported range now includes the following major drainages: American River (8 specific occurrences); Calaveras River (2 general reports); Cosumnes River (4 specific occurrences, 1 general report), and its tributary, Dry Creek (1 general report); Feather River (1 specific occurrence); Merced River (2 specific occurrences); Middle River (1 general report); Sacramento River (20 specific occurrences), and its historical tributary, Putah Creek (3 specific occurrences); Stanislaus River (2 specific occurrences), and Tuolumne River (2 general reports). Two widely-separated tributaries to the San Joaquin River, Bear Creek (2 general reports), and Los Banos Creek (1 specific occurrence) are also included. The distribution of VELB records among these drainages probably is more indicative of survey effort than of VELB distribution. These reports are distributed among the following counties: Butte, Colusa, Glenn, Merced, Napa, Sacramento, San Joaquin, Solano, Stanislaus, Sutter, Tehama, Yolo, and Yuba. In general, these data support the earlier range description of "lower Sacramento Valley to the upper San Joaquin Valley."

Due to extensive work since its listing (particularly during the past 10 years), the reported range has been extended considerably. These new data, based upon both the presence of adults and the presence of characteristic emergence holes in elderberry (*Sambucus* spp.), are well-summarized by Barr (USFWS 1991b) and define the range as extending throughout the Central Valley, from Redding (Shasta County) to Bakersfield (Kern County) (USFWS 1991b). The eastern limit is defined by several observations from the western slope of the Sierra Nevada at elevations up to approximately 3,000 feet (USFWS 1991b). The western limit, much more difficult to define due to limited data (particularly from the southwest quadrant of the Central Valley), is defined as Cold Canyon, near Lake Berryessa (Napa County). Elevations range from approximately 30 feet on the Central Valley floor to approximately 3,000 feet in the Sierra Nevada, and to approximately 700 feet in the Coast Range. In addition to those counties reported in the NDDB, VELB range is now considered to include the following counties: Shasta, Placer, El Dorado, Amador, Mariposa, Madera, Fresno, Tulare, and Kern. Cumulatively, these data support a range definition of the Central Valley, from Redding to Bakersfield, extending up to 3,000 feet on the western slope of the Sierra Nevada, and to 700 feet on the eastern slope of the Coast Range. Historically, the range of

the VELB is assumed to have included riparian zones surrounding all of the major Central Valley river drainages. These riparian corridors (and associated savannas), once much more extensive, probably offered ample habitat for the VELB.

Habitat Requirements

All stages of the VELB life cycle are closely associated with elderberry. Adults lay eggs upon the plants, after which, larvae bore in and excavate pupal cells. After pupation, new adults emerge and use elderberry for resting, foraging, and mating.

Over the past several years, there has been some speculation regarding host plant preference at the specific level. The problem has been exacerbated by taxonomic problems with *Sambucus*. Recent data indicate that VELBs infest individuals of both *S. mexicana* and *S. racemosa* var. *microbotrys*, with no distinct preference (USFWS 1991b). Similarly, there has been discussion surrounding anecdotal supposition that VELBs seem to prefer "stressed" plants. It is believed that other factors (e.g., ease of visual observation during survey efforts, and/or seasonality of plants) may have confounded this issue. Recent data indicate a clear preference (i.e., 82.5 percent) for "healthy" plants (USFWS 1991b). These data also indicate a distinct preference for larger plants (i.e., maximum branch/trunk diameter 2.5 to 30 inches; mean = 8.1 inches) (USFWS 1991b). The diameter of stems bearing recent emergence holes ranged from 1 to 8.4 inches (mean = 3.5 inches) (USFWS 1991b). Combined, these data suggest a general preference for mature, established elderberry stands; with larval utilization of healthy, somewhat younger stems (most in branches with stem diameters between 2 and 4 inches) (USFWS 1991b).

Critical Habitat

Two critical habitat zones have been established (USFWS 1991c):

1. Sacramento Zone: An area in the City of Sacramento enclosed on the north by the Route 160 freeway, on the west and southwest by the Western Pacific railroad tracks, and on the east by Commerce Circle, and its extension southward to the railroad tracks.

2. American River Parkway Zone: An area of the American River Parkway on the south bank of the American River, bounded on the north by latitude 38 37'30"N, on the west and southwest by Elmanto Drive from its junction with Ambassador Drive to its extension to latitude 38 37'30"N, and on the south and east by Ambassador Drive and its extension north to latitude 38 37'30" N, Goethe Park, and that portion of the American River Parkway northeast of Goethe Park, west of the Jedediah Smith Memorial Bicycle Trail, and north to a line extended eastward from Palm Drive.

In addition, two "essential habitat" zones have been described:

1. American River Parkway Zone: An area within the American River Parkway, consisting of both left and right banks, extending from Nimbus Dam downstream to Arden Bar, adjacent to and encompassing previously-designated "Critical Habitat, American River Parkway Zone" (USFWS 1984)

2. Putah Creek Zone: California. Solano County. Range 2 West, Township 8 North, Sections 25, 26, 35, and 36 (USFWS 1984)

Reasons for Decline

Due to a lack of historical (and current) population data, it has not been established that the VELB is still in decline. However, habitat destruction generally is accepted as the greatest threat to the species. It has been estimated that approximately 90 percent of California riparian systems have been destroyed since the mid-1800s (USFWS 1984). Anecdotal evidence regarding "clumped" distribution suggests that VELB may be relatively poor at dispersal. If true, poor dispersal would be exacerbated by habitat fragmentation. In addition, isolation renders distinct populations much more susceptible to localized upsets due to natural (e.g., fire) or unnatural (e.g., development and/or maintenance) causes. Continued destruction of riparian habitat is considered the single greatest threat to the species.

Survey Methodology

In 1984 and 1985, VELB emergence holes and adults, respectively, were reported from the Middle River, southwest of Stockton (NDDB 1992, USFWS 1991b). However, recent work in the area indicated no VELB presence, except near Dixon, Solano County (USFWS 1991b). Due to the fact that the project area is within the known range of the species, and that an historical record of its presence occurs near the ISDP area, it was considered possible that VELBs may occur.

Although elderberries likely occur along the Feather River and one record of VELB occurrence is contained in the NDDB (1992), changes in the operation of Oroville Dam are not expected to impact this species. Elderberries typically grow on high river terraces and would not be affected by the magnitude of changes in water levels projected by DWR's modeling studies.

Combined reconnaissance and follow-up surveys to determine the occurrence of elderberry plants in the project area were conducted in March, April, and June, 1993. When found plants were examined for evidence of VELB infestation, i.e., emergence holes. Adults were also searched for during April and June surveys at the same time that elderberry shrubs were examined for emergence holes.

Results

Although no evidence of VELB infestation was identified, approximately 400 elderberry plants, or discrete clusters, were identified within the ISDP area. Locations of elderberries are indicated in Appendix A, Figures A-9, A-10, A-15, A-16, A-17, A-18, A-19, A-20, A-21, and A-22. According to USFWS guidelines, all elderberry plants with stems of 1 inch or greater diameter at ground level constitute potential habitat for the VELB.

Impacts of the Proposed Project

No elderberry plants were identified in areas subject to direct impacts (e.g., construction-related or facility placement) of any ISDP components; therefore, no adverse impacts to this species are anticipated. No elderberries are located at any of the sites proposed for flow control structures or at the proposed northern intake although elderberries do occur on the Old River upstream of the Old River Fish Control Structure and on Grant Line/Fabian and Bell canals upstream of the proposed Grant Line Flow Control Structure. Water levels and flow rates within ISDP waterways are expected to change due to project operations; however, elderberry plants typically grow on the higher riparian terraces and would not be impacted by the changes anticipated.

Mitigation Measures

None required.

Impacts of Alternatives

Only one of the alternatives being considered, Alternative 3, could adversely impact VELBs and their elderberry host plant. Alternative 3 includes extending and/or consolidating agricultural diversions as one of its components. This would involve the removal of some of the existing diversions and the consolidation of several diversions into one large structure. It is likely that the placement of the new larger structures would be located on islands that are currently most affected by low water levels, which would put the new structures proximate to the barriers. Elderberry plants growing in one of these locations could be disturbed or removed due to facility construction.

Mitigation Measures

Once the locations of the new diversions are determined, if elderberries are present in the vicinity, they should be marked and fenced. A setback of at least 20 feet from the dripline of each elderberry should be maintained during construction activities (USFWS 1994). Construction of the new diversions should avoid the shrubs where possible. If it is not possible to avoid them, shrubs should either be transplanted or additional stems (cuttings or seedlings) should be planted following construction at a ratio of 2:1 for all stems that are removed with diameters of 1.0 inch or greater at ground level. This planting ratio assumes that there are no emergence holes. If emergence holes are discovered, planting ratios shall be at 3:1 or 5:1 according to USFWS (1994) guidelines.

Cumulative Impacts

A cumulative impacts analysis will be included in the Draft EIR/EIS to be released in 1996 (Entrix in preparation). In the Administrative Draft EIR/EIS (Entrix 1995) cumulative impacts of the ISDP are discussed in connection with 16 water-related projects that have been proposed in central and northern California and have undergone some type of environmental review. A summary of potentially significant impacts is provided separately for each project. Even though individual projects may have adverse impacts on sensitive animal species due to the loss of riparian vegetation and wetland habitats, the potential project-related cumulative effects upon these resources are being addressed by a number of entities through the initiation of actions and programs specifically designed to improve the habitat conditions for fish and wildlife resources residing in, or migrating through, the Sacramento/San Joaquin Delta (Entrix 1995). These measures are designed to balance the potential effects of existing and future cumulative actions in the Delta, including water resources actions, with appropriate environmental protection efforts for fish and wildlife resources residing in, or migrating through, the Delta.

While the ISDP, in conjunction with other proposed water-related projects, may have significant cumulative impacts upon certain fisheries resources, it would not result in significant cumulative impacts to endangered, threatened, candidate, or other sensitive animal species discussed in this Biological Assessment. As Entrix (1995) points out in the Administrative Draft EIR/EIS, "the ISDP would not facilitate significant population growth in the central and southern California service areas;" therefore, any potentially significant effects of the ISDP are almost exclusively confined to the Delta and its immediate vicinity. Mitigation measures have been proposed in this Biological Assessment to reduce all potentially significant impacts of the ISDP to less-than-significant levels.

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VII. REFERENCES

Literature Cited

American Ornithologist's Union. 1983. Checklist of North American birds. 6th edition.

Babcock, K.W. 1993. Home range and habitat analysis of Swainson's hawks in West Sacramento. Report by Michael Brandman Associates prepared for the Southport Property Owner's Group, City of West Sacramento, CA. 21 pp.

Beedy, E.C., S.D. Sanders, and D.A. Bloom. 1991 . Breeding status, distribution, and habitat associations of the tricolored blackbird (*Agelaius tricolor*), 1850-1989. Jones & Stokes Associates, Inc., Sacramento, California. Prepared for U.S. Fish and Wildlife Service, Sacramento, CA. 41 pp + appendices.

Bloom, P.H. 1980. The status of the Swainson's hawk in California in 1979. Wildlife Management Branch, California Department of Fish and Game and U.S. Bureau of Land Management, Sacramento, CA. 42 pp.

Brode, J.M. and G.E. Hansen. 1992. Status and future management of the giant garter snake (*Thamnophis gigas*) within the southern American Basin, Sacramento and Sutter counties, California. Department of Fish and Game, Inland Fisheries Division, Endangered Species Report. 24 pp.

Browning, B.M. and J.W. Speth. 1973. The natural resources of San Diego Bay: their status and future. Coastal Wetlands Series No. 5. California Department of Fish and Game. Sacramento, CA.

California Native Plant Society. 1994. Inventory of rare and endangered vascular plants of California. Special Publication No. 1, 5th edition. M.W. Skinner and B.M. Pavlik, eds. February 1994. 338 pp.

Department of Fish and Game. 1988. California's wildlife, volume I - amphibians and reptiles. D.C. Zeiner, W.F. Laudenslayer, Jr., and K.E. Mayer (eds.). Sacramento, CA. May 2, 1988. 272 pp.

_____. 1990a. California's wildlife, volume II - birds. D.C. Zeiner, W.F. Laudenslayer, Jr., K.E. Mayer, and M. White (eds.). Sacramento, CA. November 1990. 731 pp.

_____. 1990b. California's wildlife, volume III - mammals. D.C. Zeiner, W.F. Laudenslayer, Jr., K.E. Mayer, and M. White (eds.). Sacramento, CA. April 1990. 407 pp.

_____. 1990c. Draft mitigation guidelines for Swainson's hawks (*Buteo swainsoni*) in the Central Valley of California. Nongame Wildlife Section, Sacramento, CA. 12 pp.

_____. 1992a. 1991 annual report on the status of California state listed threatened and endangered plants and animals. Sacramento, CA. 191 pp.

_____. 1992b. The South Delta barriers project - assessment of existing fish, wildlife and plant community resources and potential project impacts. February 14, 1992. 92 pp + appendices.

_____. 1993a. The South Delta barriers project, 1993 - assessment of existing fish, wildlife and plant community resources and potential project impacts. January 1, 1993. 76 pp + appendices.

_____. 1993b. Protocols for pre-project surveys to determine presence or absence of the giant garter snake (GGS) and to evaluate habitats. Prepared by John M. Brode, Inland Fisheries Branch. March 1993.

_____. 1994a. Staff report regarding mitigation for impacts to Swainson's hawks (*Buteo swainsoni*) in the Central Valley of California. Nongame Wildlife Section, Sacramento, CA. June 26, 1994. 14 pp.

_____. 1994b. Draft mitigation guidelines for the giant garter snake (*Thamnophis gigas*). Revised March 22, 1994.

Department of Water Resources, Office of Environmental Services. 1992. Biological assessment for South Delta temporary barriers project. February 1992.

_____. 1994. Temporary barriers project: fishery, water quality, and vegetation monitoring, 1993. February 1994. 169 pp + appendices.

_____ and U.S. Bureau of Reclamation. 1990. Draft Environmental Impact Report/ Environmental Impact Statement South Delta Water Management Program. June 1990. 494 pp.

ECOS, Inc. 1987. South Delta water management project biological assessment. Prepared for U.S. Bureau of Reclamation, Mid-Pacific Region, Sacramento, CA.

_____. 1990a. Sensitive species survey report for the south Delta water management project. Prepared for U.S. Bureau of Reclamation, Mid-Pacific Region and Department of Water Resources, Division of Planning, Sacramento, CA. September 1990. 44 pp + appendices.

_____. 1990b. Sensitive species survey report for the north Delta water management project. Prepared for U.S. Bureau of Reclamation, Mid-Pacific Region and Department of Water Resources, Division of Planning, Sacramento, CA. July 1990. 43 pp + appendices.

Ehrlich, P.R., D.S. Dobkin, and D. Wheye. 1988. The birder's handbook, a field guide to the natural history of North American birds. Simon and Schuster, New York.

Entrix. 1995. Administrative Draft Environmental Impact Report/Environmental Impact Statement Interim South Delta Program. May 1995. Various paging.

ESA/Madrone. 1982. Wetlands policy assessment California case study, Novato, CA. Prepared for the Office of Technology Assessment, Washington, D.C.

Estep, J.A. 1989. Biology, movements, and habitat relationships of the Swainson's hawk in the Central Valley of California, 1986-87. California Department of Fish and Game, Nongame Bird and Mammal Section, Sacramento, CA. 52 pp.

Evens, J. and G.W. Page. 1986. Predation on black rails during high tides in salt marshes. Condor 88:107-109

Fitch, H.S. 1940. A biogeographical study of the *ordinoides* artenkreis of garter snakes (genus *Thamnophis*). Univ. Calif. Publ. Zool. 44:1-150.

Gill, R. and A.R. Buckman. 1974. The natural resources of the Suisun Marsh, their status and future. (Coastal Wetlands Series No. 9) California Department of Fish and Game. Sacramento, CA.

Golden, M.L. and P.L. Fiedler. 1991. Characterization of the habitat for *Lilaeopsis masonii* (*Umbelliferae*): a California state-listed rare plant species. California Department of Fish and Game Endangered Plant Program, Sacramento, CA. June 3, 1991. 72 pp + appendices.

Griffin, J.R. and W.B. Critchfield. 1972. The distribution of forest trees in California. U.S. Department of Agriculture, Forest Service, Pacific Southwest Forest and Range Experiment Station. Research Paper PSW-82. 114 pp.

Grinnell, J. and A.H. Miller. 1944. The distribution of the birds of California. Pacific Coast Avifauna No. 27. Museum of Vertebrate Zoology, University of California Berkeley, Berkeley, CA. 608 pp.

Hansen, G.E. 1988. Review of the status of the giant garter snake (*Thamnophis couchi gigas*) and its supporting habitat during 1986-1987. Final report for California Department of Fish and Game, Contract C-2060. 31 pp.

_____. 1992. Potential supporting habitat of the giant garter snake along the Feather River, west bank (site 3), Sacramento River flood control project. Prepared for Entrix, Inc., Sacramento, CA. 6 pp.

_____ and J.M. Brode. 1980. Status of the giant garter snake *Thamnophis couchii gigas* (Fitch). Inland Fisheries Endangered Species Program Special Publication 80(5):1-14. California Department of Fish and Game, Sacramento, CA.

_____. 1993. Results of relocating canal habitat of the giant garter snake (*Thamnophis gigas*) during the widening of State Route 99/70 in Sacramento and Sutter counties, California. Final report for Caltrans. Interagency Agreement 03E325 (FG7550).

Holland, D.C. and R.B. Bury. 1992. Status of the western pond turtle (*Clemmys marmorata*) in 1991. Paper presented at the Western Section of the Wildlife Society annual meeting, San Diego, CA.

Holt, W. In preparation. Swainson's hawks (*Buteo swainsoni*) wintering in the Sacramento/San Joaquin River Delta of California.

Huey, L.M. 1916. The farallon rails of San Diego County. Condor 18:58-62.

Jones & Stokes Associates. 1990a. Draft EIR/EIS for the Delta islands project of Delta Wetlands, a California Corporation. Prepared for the State Water Resources Control Board, Division of Water Rights, and U.S. Army Corps of Engineers, Sacramento District, Sacramento, CA. December 1990. Various paging.

_____. 1990b. Habitat conservation plan for the Swainson's hawk in San Joaquin County. Prepared for the Community Development Department, Stockton, CA.

_____. 1992. Biological assessment for federal threatened, endangered, and candidate species for the Los Vaqueros Project. Prepared for U.S. Bureau of Reclamation, Sacramento, CA, and Contra Costa Water District, Concord, CA. August 6, 1992. Various paging.

Linsley, E.G. and J.A. Chemsak. 1972. *Cerambycidae* of North America, Part VI, No. 1, taxonomy and classification of the subfamily Lepturinae. University of California Publications in Entomology 69:1-8.

McCarten, N.F. and R. Ornduff. 1990. Report on a study of sensitive plant species occurring in the Delta Meadows State Recreation Area. Prepared for Department of Parks and Recreation: Inland Region, Lodi, CA. October 25, 1990. 16 pp.

Manolis, T. 1978. Status of the black rail in central California. Western Birds 9:151-158.

Miriam Green Associates. 1993. Phase I report - sensitive species: Interim South Delta Project. Prepared for U.S. Bureau of Reclamation, Mid-Pacific Region and State of California, Department of Water Resources. February 12, 1993. Various paging.

Mudie, P.J. 1970. A survey of the coastal wetland vegetation of San Diego Bay. California Department of Fish and Game, Sacramento, CA.

Munz P.A. and D.D. Keck. 1968. A California flora with supplement. University of California Press, Berkeley. 1,681 pp + 224 page supplement.

Natural Diversity Data Base. 1992. Computer printout of sensitive species records in California. Updated version as of September 30, 1992. California Department of Fish and Game, Natural Heritage Division, Sacramento, CA.

_____. 1992. Computer printout of sensitive species records in California. Updated version as of December 30, 1994. California Department of Fish and Game, Natural Heritage Division, Sacramento, CA.

Niehaus, T. 1977a. Rare plant status report: *Aster chilensis* var. *lentus*. California Native Plant Society, Sacramento. 1 pp.

_____. 1977b. Rare plant status report: *Lathyrus jepsonii* Greene ssp. *jepsonii*. California Native Plant Society, Sacramento. 1 pp.

Pogson, T.H. and S.M. Lindstedt. 1988. Abundance, distribution and habitat of Central Valley population greater sandhill cranes during winter. University of Alaska, Department of Biology and Wildlife, Fairbanks, AK. 52 pp.

_____. 1991. Distribution and abundance of large sandhill cranes, *Grus canadensis*, wintering in California's Central Valley. Condor 93:266-278.

Repking, C.F. and R.D. Ohmart. 1977. Distribution and density of black rail populations along the lower Colorado River. Condor 79:486-489.

Ripley, S.D. 1977. Rails of the world. A monograph of the family Rallidae. David R. Godine, Boston, MA.

_____ and B.M. Beehler. 1985. Rails of the world, a compilation of new information, 1975-1983 (Aves: Rallidae) Smithsonian Institute Press, Washington, D.C.

Robbins, C.S., B. Bruun, and H.S. Zim. 1966. Birds of North America. New York. Golden Press.

Rossman, D.A. and G.R. Stewart. 1987. Taxonomic reevaluation of *Thamnophis couchii* (Serpentes: Colubridae). Occ. Papers Mus. Zool. Louisiana State University, Baton Rouge. 63:1-25.

Small, A. 1994. California birds: their status and distribution. Ibis Publishing Company, Vista, CA.

Smith, F. 1977. Short review of the status of riparian forests in California *In* A. Stet (ed.), Riparian forests in California: their ecology and conservation. Institute of Ecology, Publication 15. University of California, Davis.

State Water Resources Control Board. 1991. Technical appendix: water quality control plan for salinity. San Francisco Bay/Sacramento-San Joaquin Delta Estuary. Report #91-16 WR). May 1991.

Stebbins, R.C. 1985. A field guide to western reptiles and amphibians. 2nd edition. Houghton Mifflin Company, Boston, MA.

Treanor, R.R. 1983. Contributions to the biology of the bullfrog, *Rana catesbeiana* Shaw, in California. Administrative Report No. 83-1. Department of Fish and Game, Inland Fisheries Branch, Rancho Cordova, CA.

U.S. Fish and Wildlife Service. 1984. Valley elderberry longhorn beetle recovery plan. U.S. Fish and Wildlife Service, Portland, OR. 62 pp.

_____. 1991a. Endangered and threatened wildlife and plants: proposed endangered status for the giant garter snake. Federal Register 56(249):67046-67053. December 27, 1991.

_____. 1991b. The distribution, habitat, and status of the Valley elderberry longhorn beetle, *Desmocerus californicus dimorphus* (Insecta: *Coleoptera: Cerambycidae*). U.S. Fish and Wildlife Service, Sacramento, CA. 134 pp.

_____. 1991c. "Critical habitat - fish and wildlife." Code of Federal Regulations. Title 50, Part 17, Subpart "I," Section 17.95. 1991 ed. 235-236.

_____. 1992. Endangered and threatened wildlife and plants: 90-day finding and commencement of status reviews for a petition to list the western pond turtle and California red-legged frog. Federal Register 57(193):45761-45762. October 5, 1992.

_____. 1993. Endangered and threatened wildlife and plants: determination of threatened status for the giant garter snake. Federal Register 58(201):54053-54066. October 20, 1993.

_____. 1994a. Sacramento urban area levee reconstruction project: Sacramento River Swainson's hawk nesting population study, 1992. Unpublished report. U.S. Fish and Wildlife Service, Sacramento, CA.

_____. 1994b. General compensation guidelines for the valley elderberry longhorn beetle. Prepared by the U.S. Fish and Wildlife Service Endangered Species Office, Sacramento, CA. 7 pp.

Warner, R.E. and K.M. Hendrix, eds. 1984. California riparian systems; ecology, conservation, and productive management. University of California Press, Berkeley, CA.

Yee, D.G. 1990. Field checklist of the birds of San Joaquin County. San Joaquin Audubon Society, Stockton, CA.

_____, B.E. Deuel, and S.F. Bailey. 1991. Northern California regional report. American Birds Vol. 45. National Audubon Society, New York.

Personal Communications

Brode, John. May 1992 through May 1995. Herpetologist. Department of Fish and Game, Region II, Rancho Cordova, CA. Telephone conversations and meetings.

Estep, James E. September, October 1990, December 7, 1992. Biologist. Jones & Stokes Associates, Inc. Sacramento, CA. Telephone conversations.

Gifford, Dan. April 18, 1993. Unit Biologist. California Department of Fish and Game, Stockton, CA. Telephone conversation.

Grewell, Brenda J. January and September, 1995. Environmental Specialist. Department of Water Resources, Environmental Services Office, Sacramento, CA. Telephone conversations.

Jennings, Mark. December 13, 1992. Research Associate. California Academy of Sciences, Department of Herpetology, San Francisco, CA. Letter to George Hansen regarding the proposal to list the western pond turtle and California red-legged frog.

Manolis, Tim. March 23, 1993. Field Ornithologist. Sacramento CA. Telephone conversation.

Nagano, Chris. December 10, 1992. Invertebrate Biologist. U.S. Fish and Wildlife Service, Fish and Wildlife Enhancement, Sacramento Field Office, Sacramento, CA. Personal interview.

Rogers, Ron. January 31, 1993. Wildlife Habitat Supervisor. California Department of Fish and Game, Region II, Rancho Cordova, CA. Meeting.

Shaffer, Kevin. September, 1995. Wildlife Biologist, Plant Conservation Program, Department of Fish and Game Natural Heritage Division, Sacramento, CA. Telephone conversation.

Sorensen, Peter. October 1992 through December 1993; May 1994. Biologist. U.S. Fish and Wildlife Service, Endangered Species Office, Sacramento, CA. Telephone conversations and meetings.

Yee, David. March through July, 1994. Biologist. San Joaquin Audubon Society, Stockton, CA. Telephone conversations and meetings.

APPENDIX A

Locations of Sensitive Species in the Interim South Delta Program Area

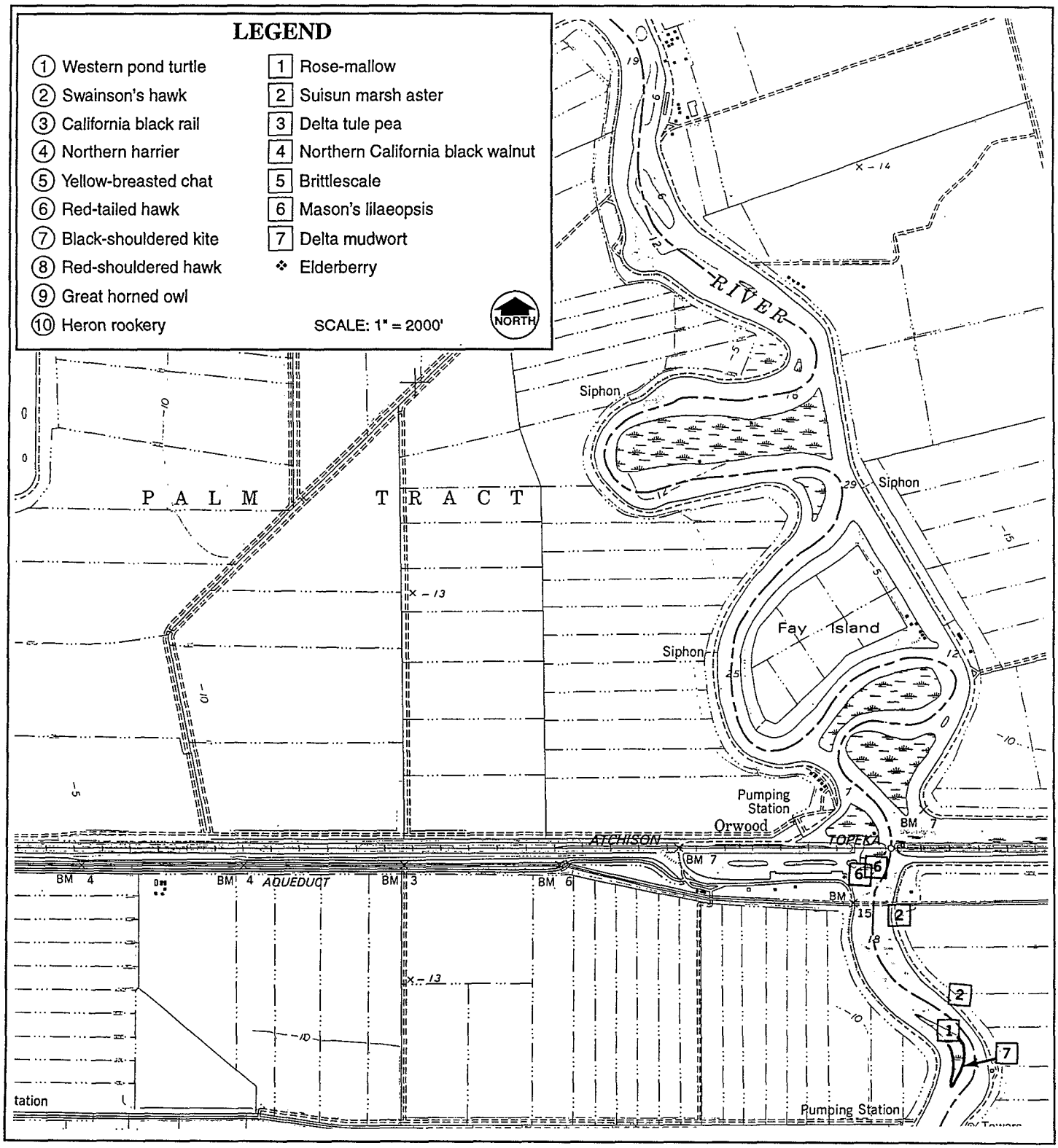

Figure A-1. Locations of Sensitive Species on the USGS Woodward Island 7.5' topographic quadrangle, center portion [Source: MGA 1994]

C-052524

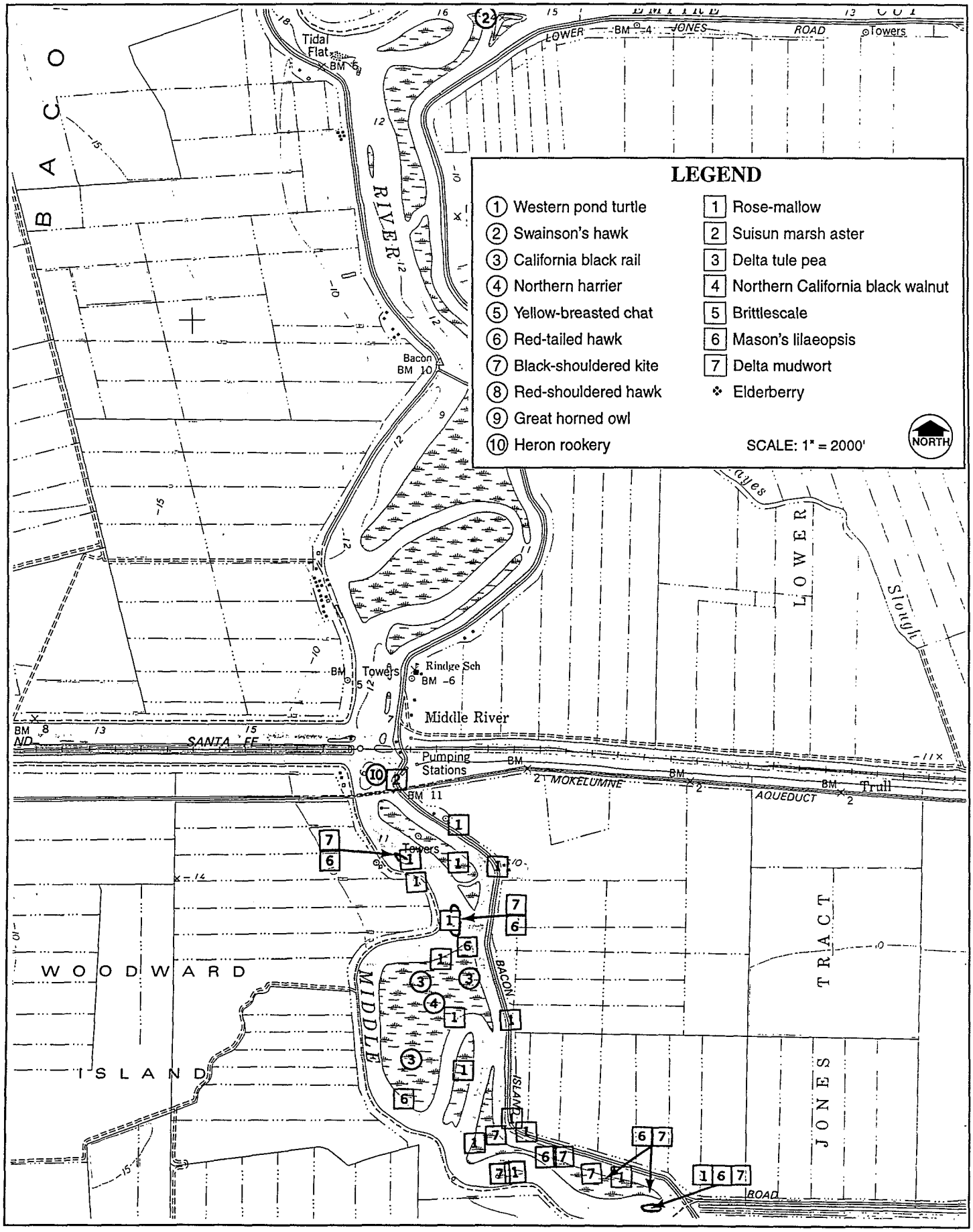

Figure A-2. Locations of Sensitive Species on the USGS Woodward Island 7.5' topographic quadrangle, NE portion [Source: MGA 1994]

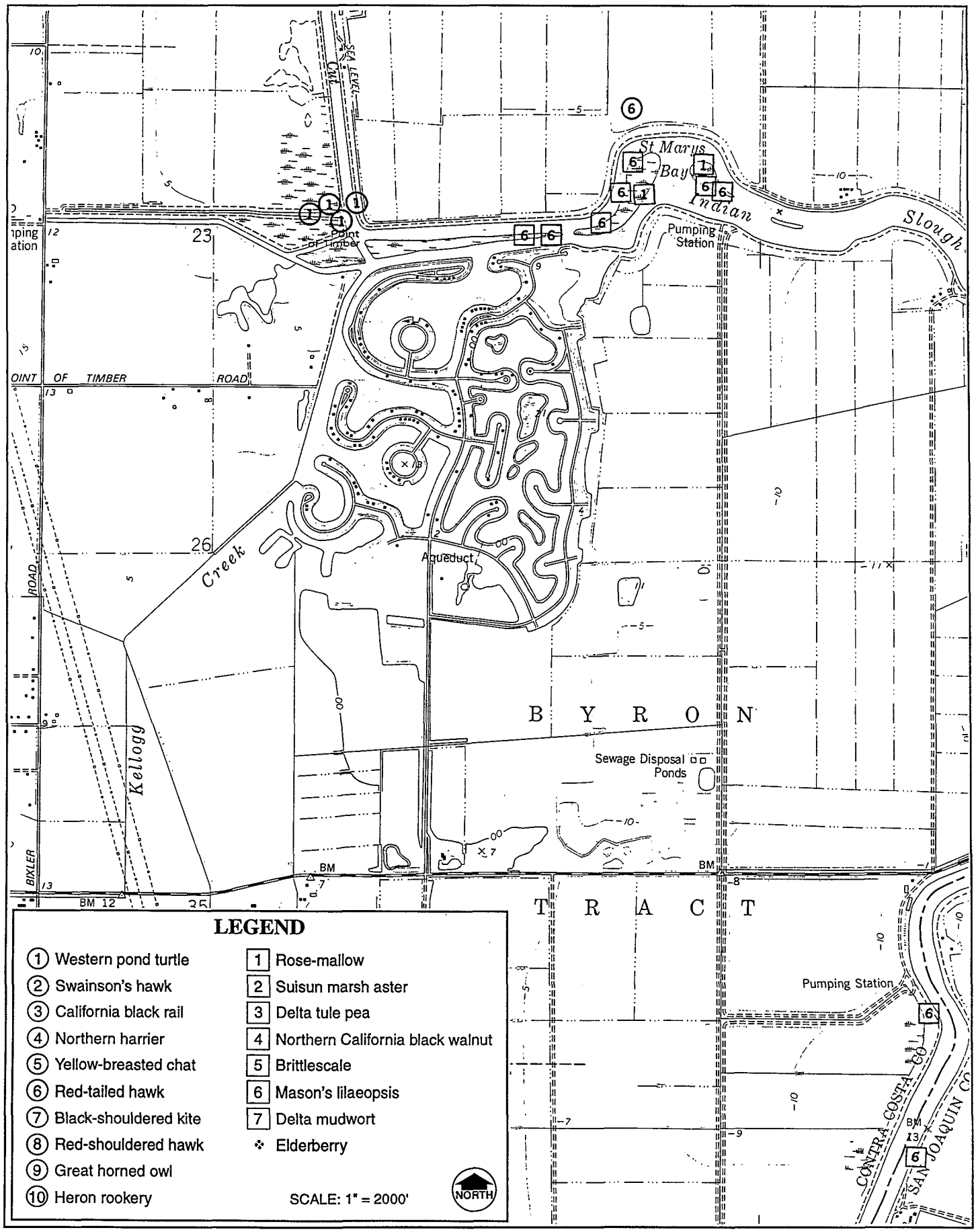

Figure A-3. Locations of Sensitive Species on the USGS Woodward Island 7.5' topographic quadrangle, SW portion [Source: MGA 1994]

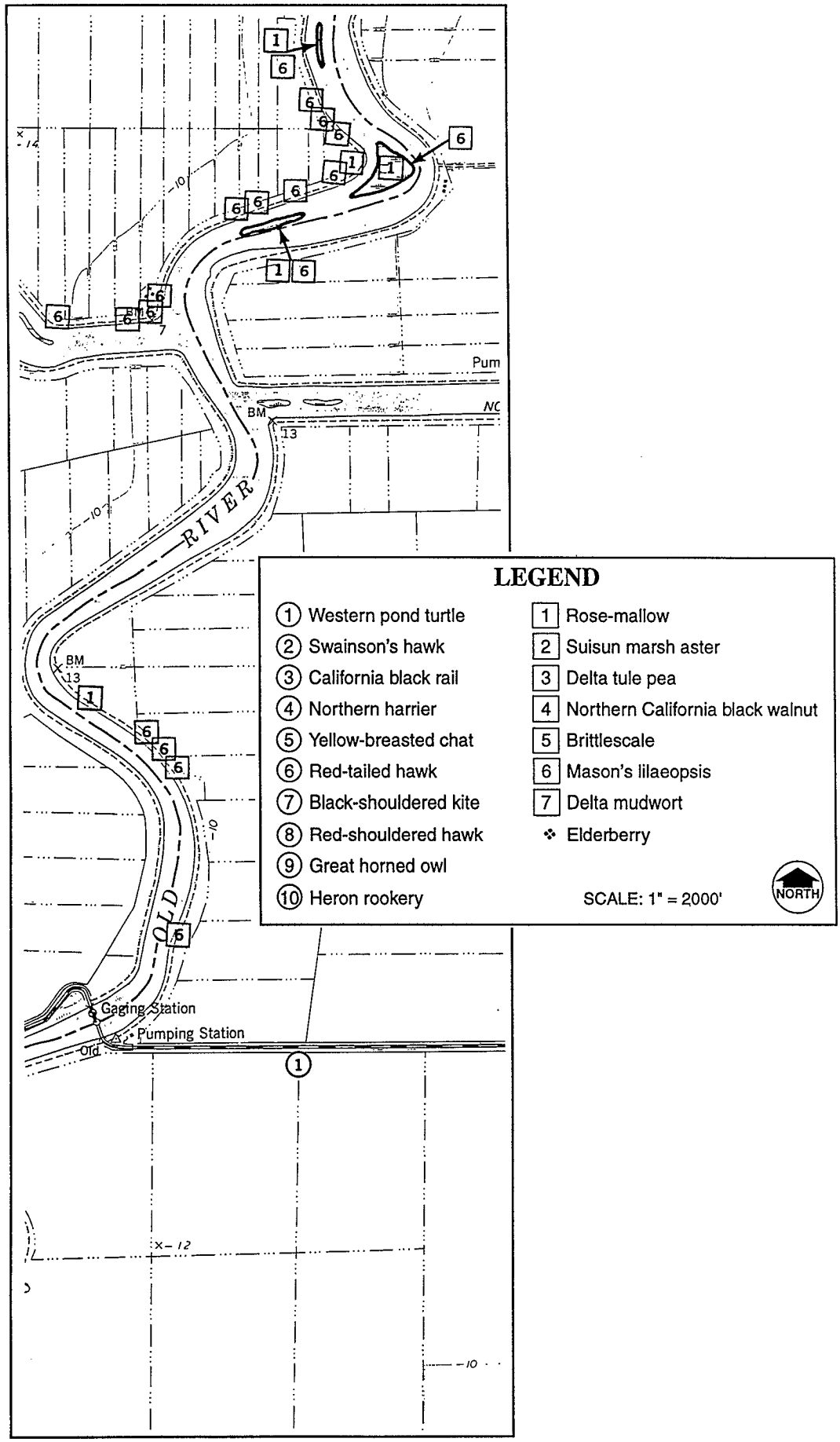

Figure A-4. Locations of Sensitive Species on the USGS Woodward Island 7.5' topographic quadrangle, S center portion [Source: MGA 1994]

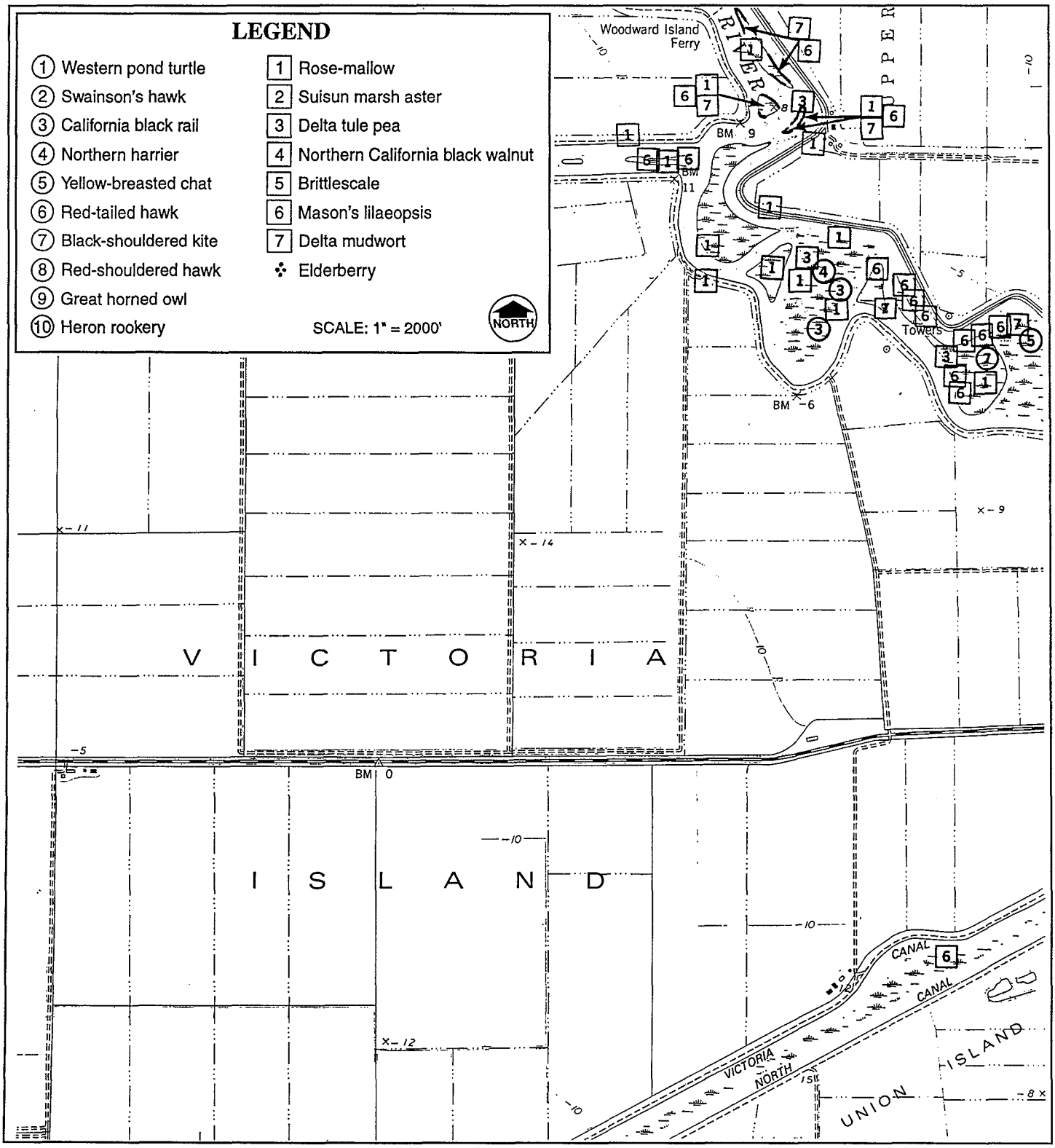

Figure A-5. Locations of Sensitive Species on the USGS Woodward Island 7.5' topographic quadrangle, SE portion [Source: MGA 1994]

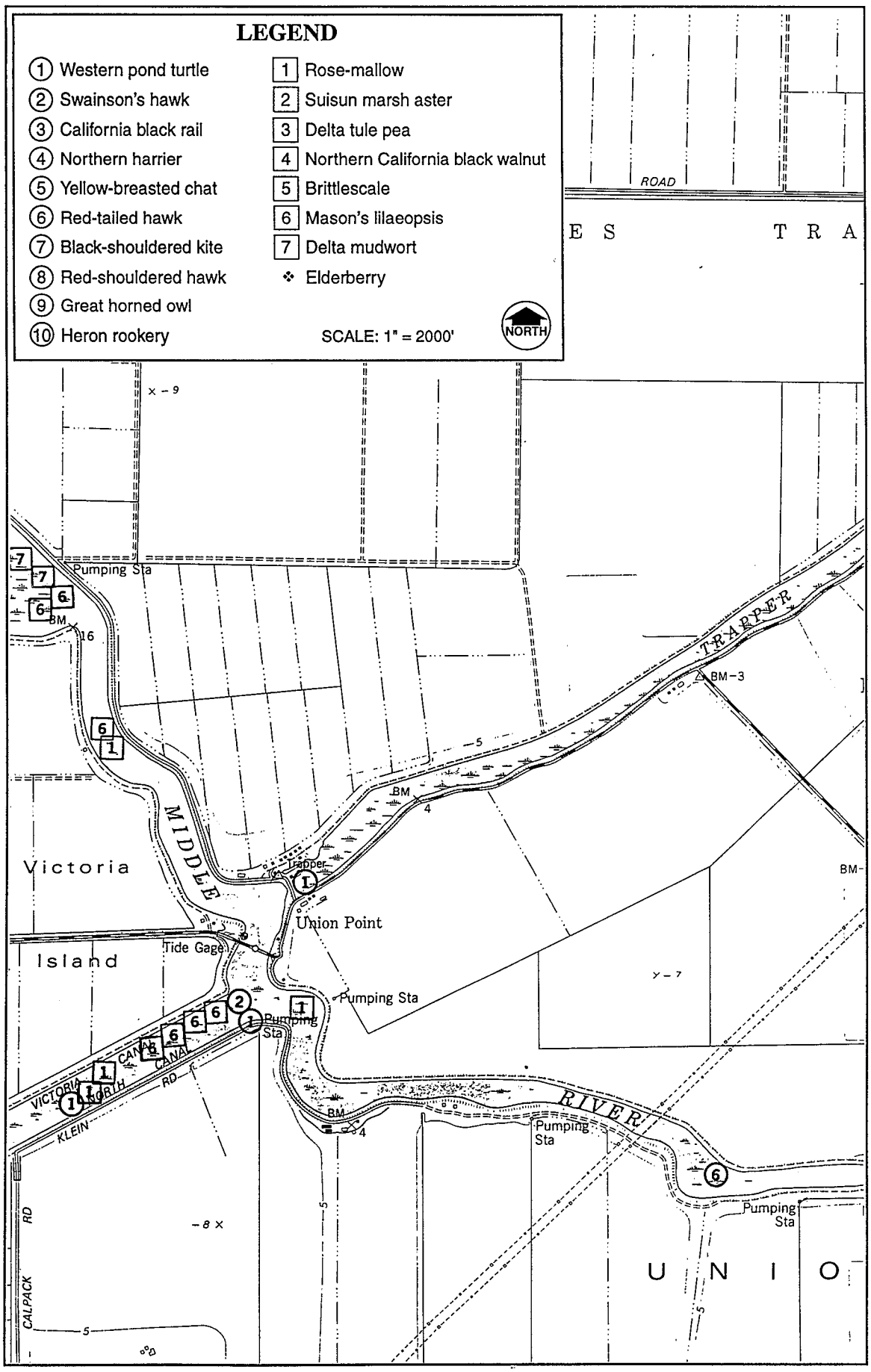

Figure A-6. Locations of Sensitive Species on the USGS Holt 7.5' topographic quadrangle, SW portion [Source: MGA 1994]

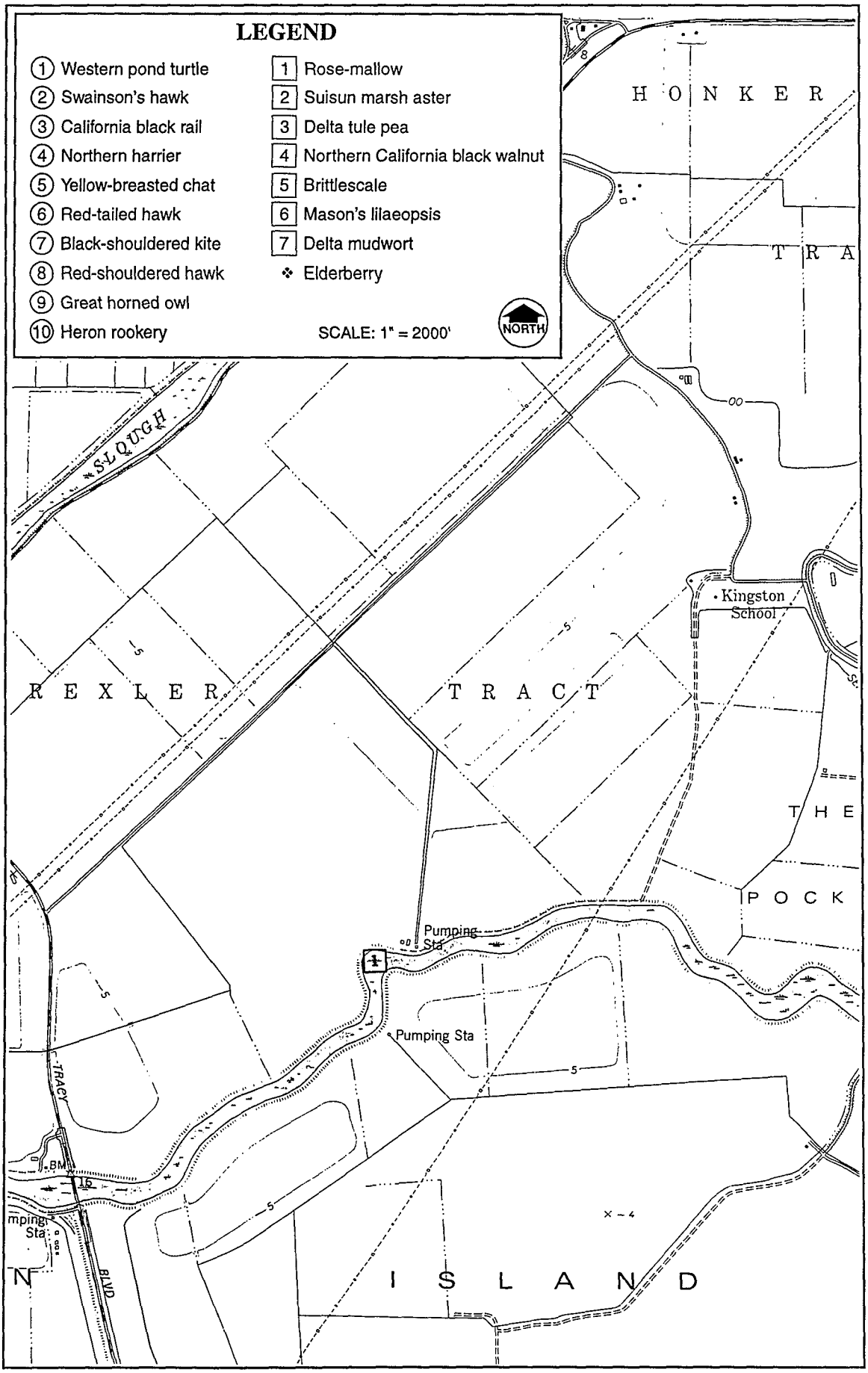

Figure A-7. Locations of Sensitive Species on the USGS Holt 7.5' topographic quadrangle, S center portion [Source: MGA 1994]

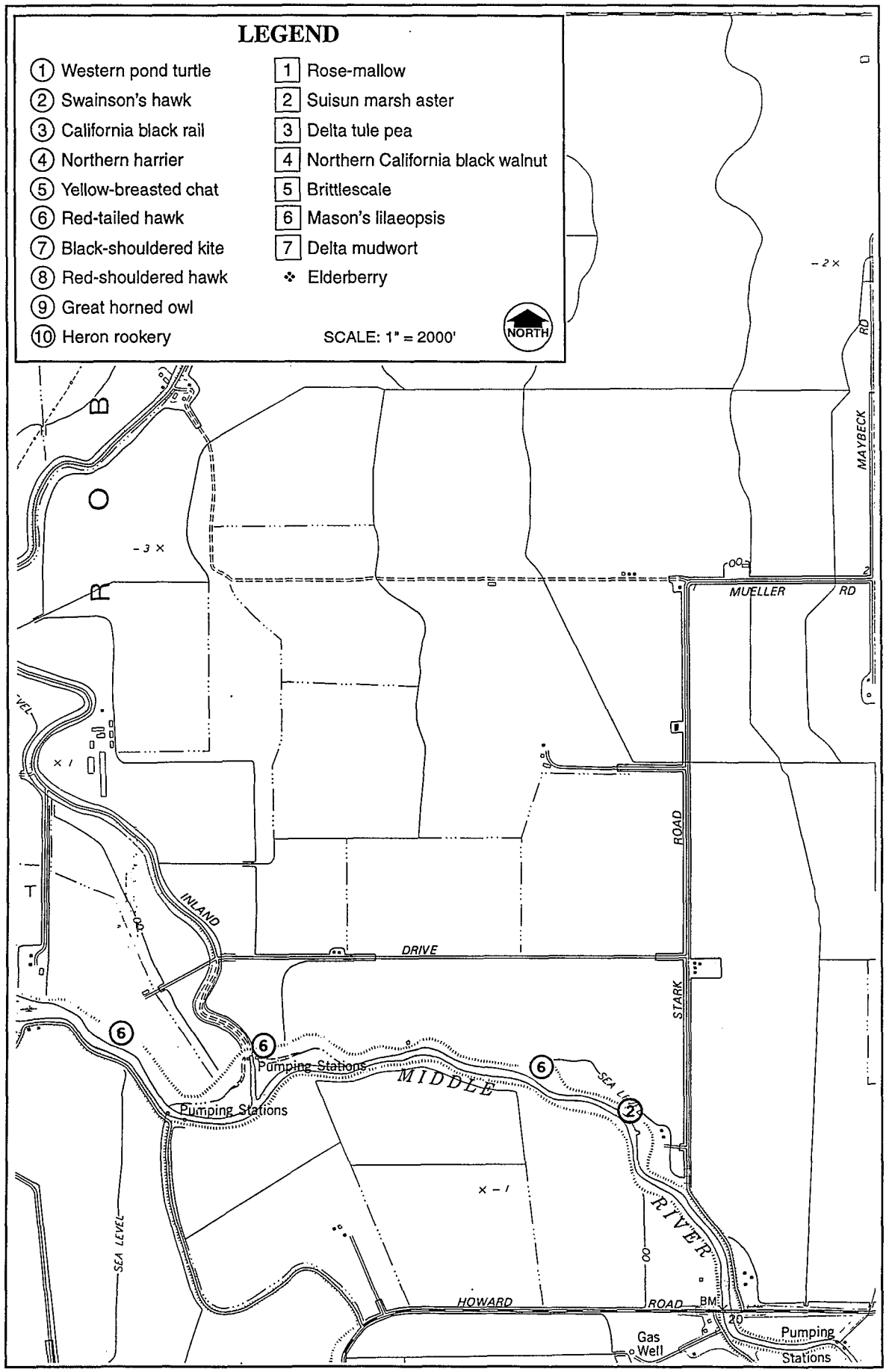

Figure A-8. Locations of Sensitive Species on the USGS Holt 7.5' topographic quadrangle, SE portion [Source: MGA 1994]

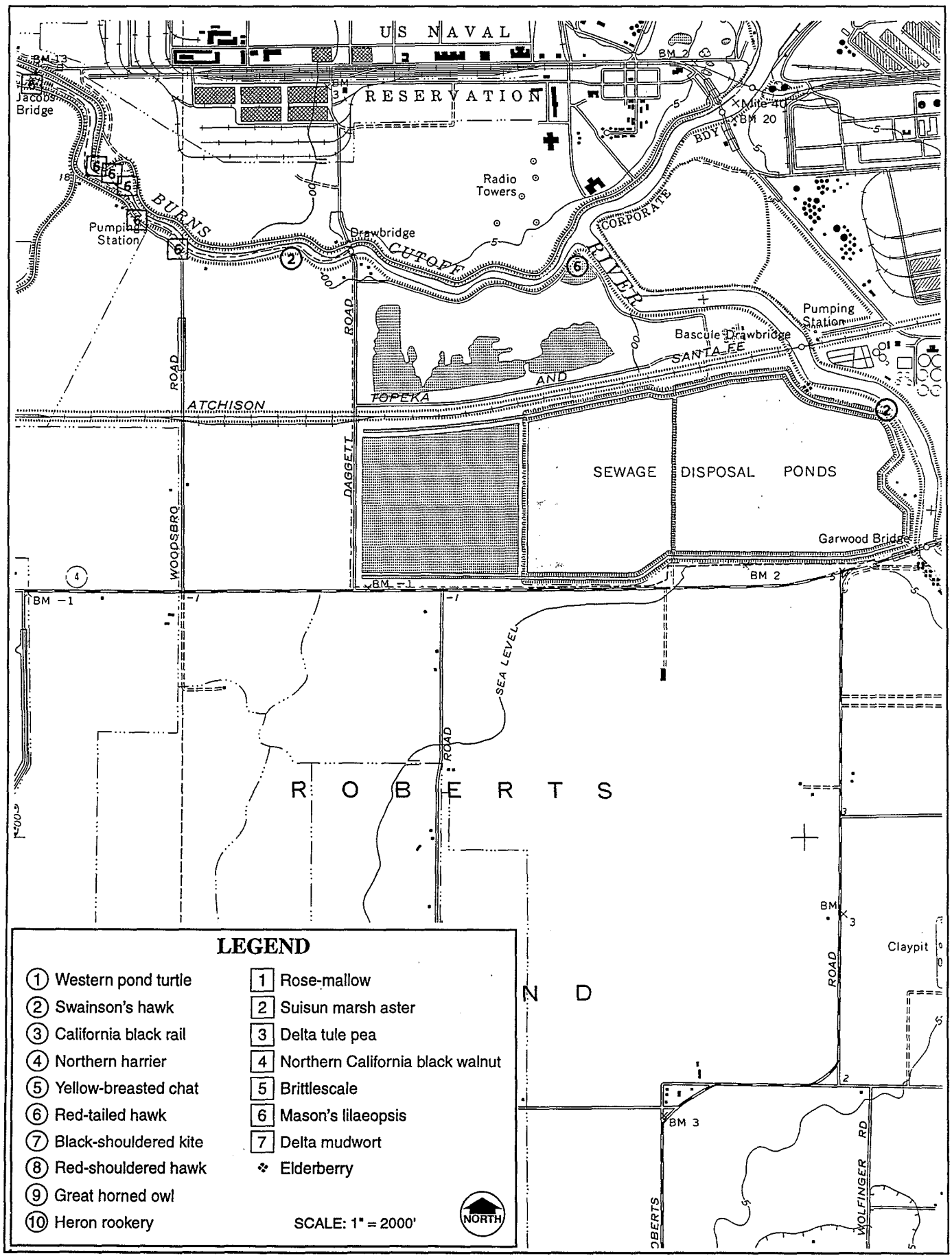

Figure A-9. Locations of Sensitive Species on the USGS Stockton West 7.5' topographic quadrangle, center W portion [Source: MGA 1994]

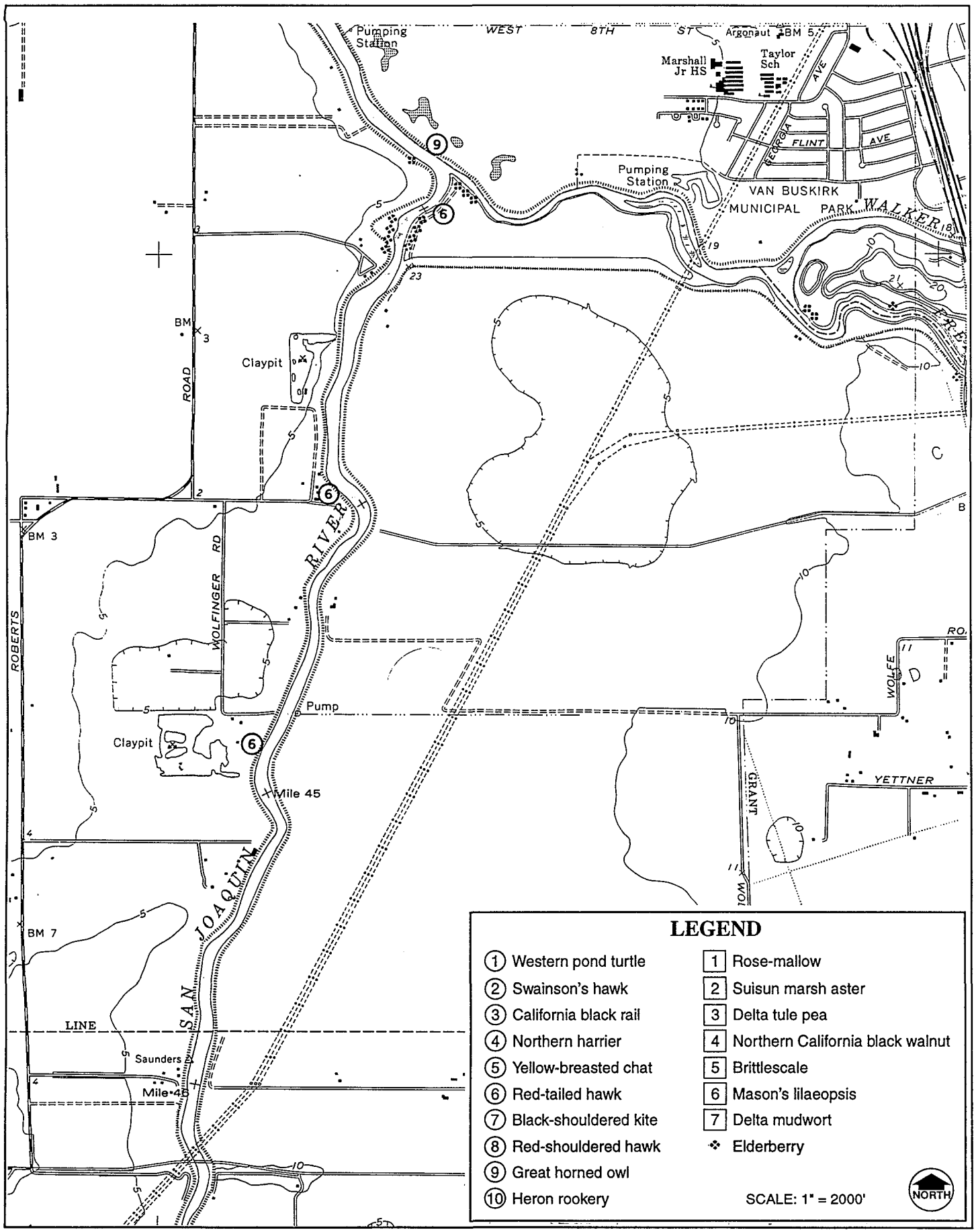

Figure A-10. Locations of Sensitive Species on the USGS Stockton West 7.5' topographic quadrangle, SW portion [Source: MGA 1994]

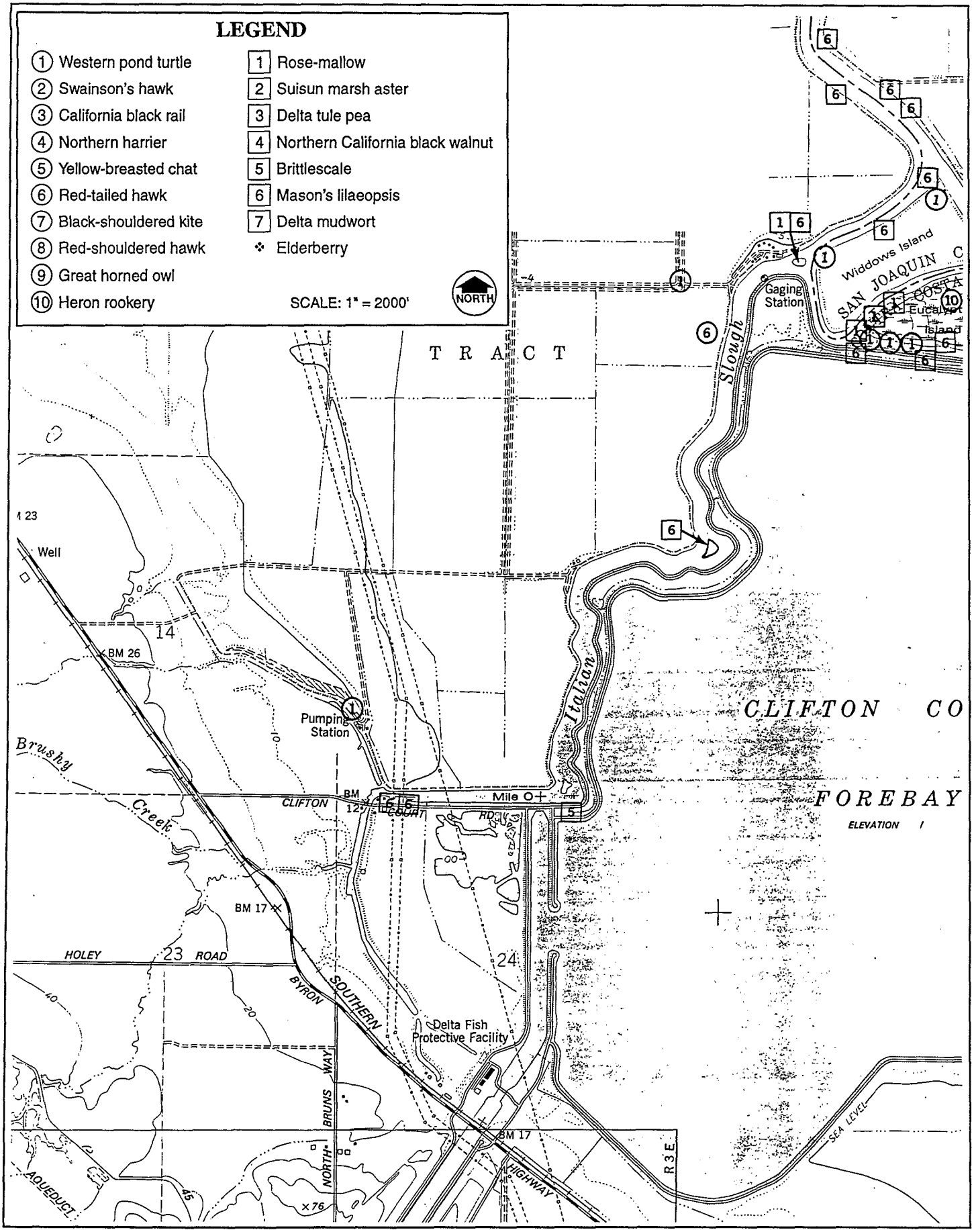

Figure A-11. Locations of Sensitive Species on the USGS Clifton Court Forebay 7.5' topographic quadrangle, NW portion [Source: MGA 1994]

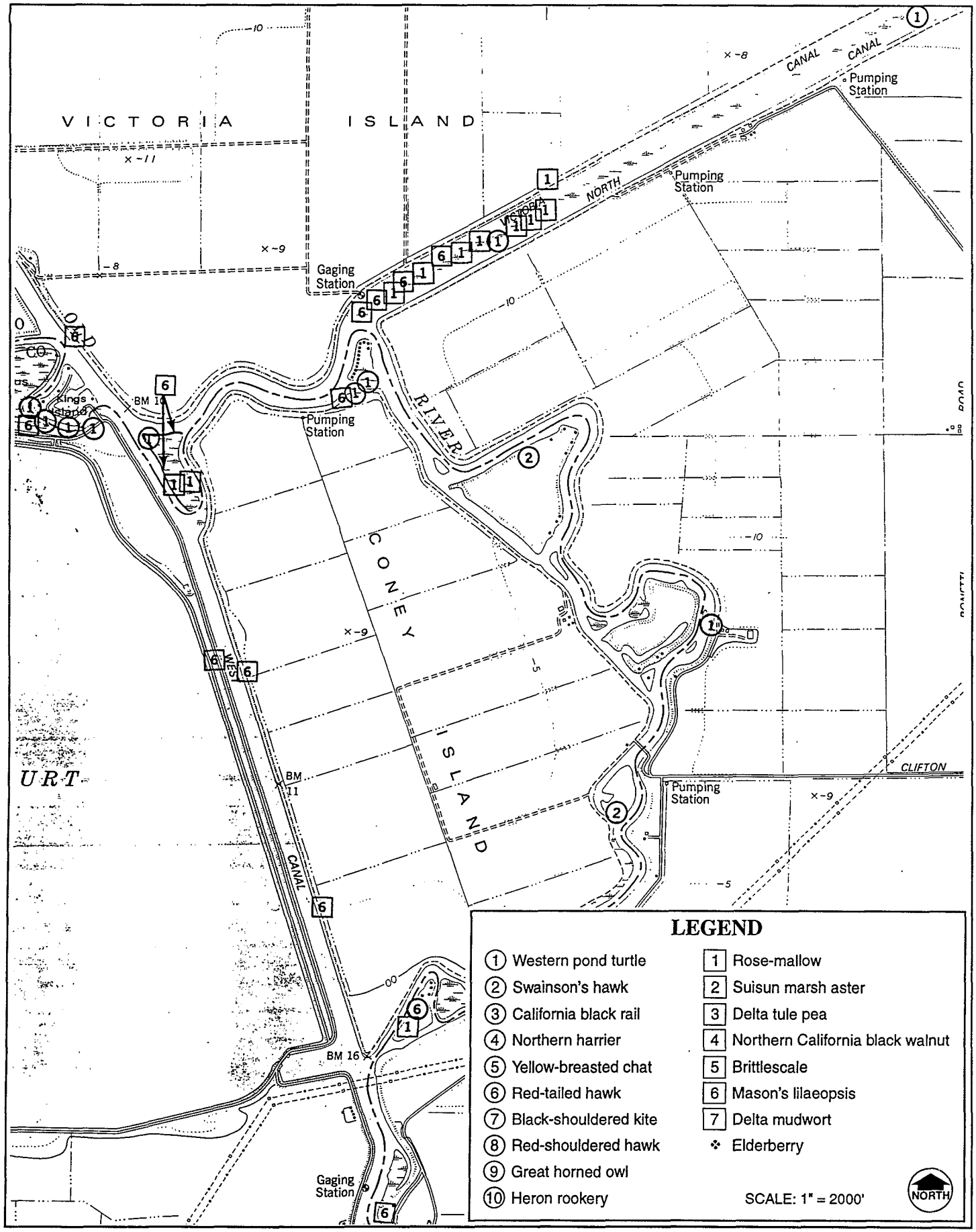

Figure A-12. Locations of Sensitive Species on the USGS Clifton Court Forebay 7.5' topographic quadrangle, NE portion [Source: MGA 1994]

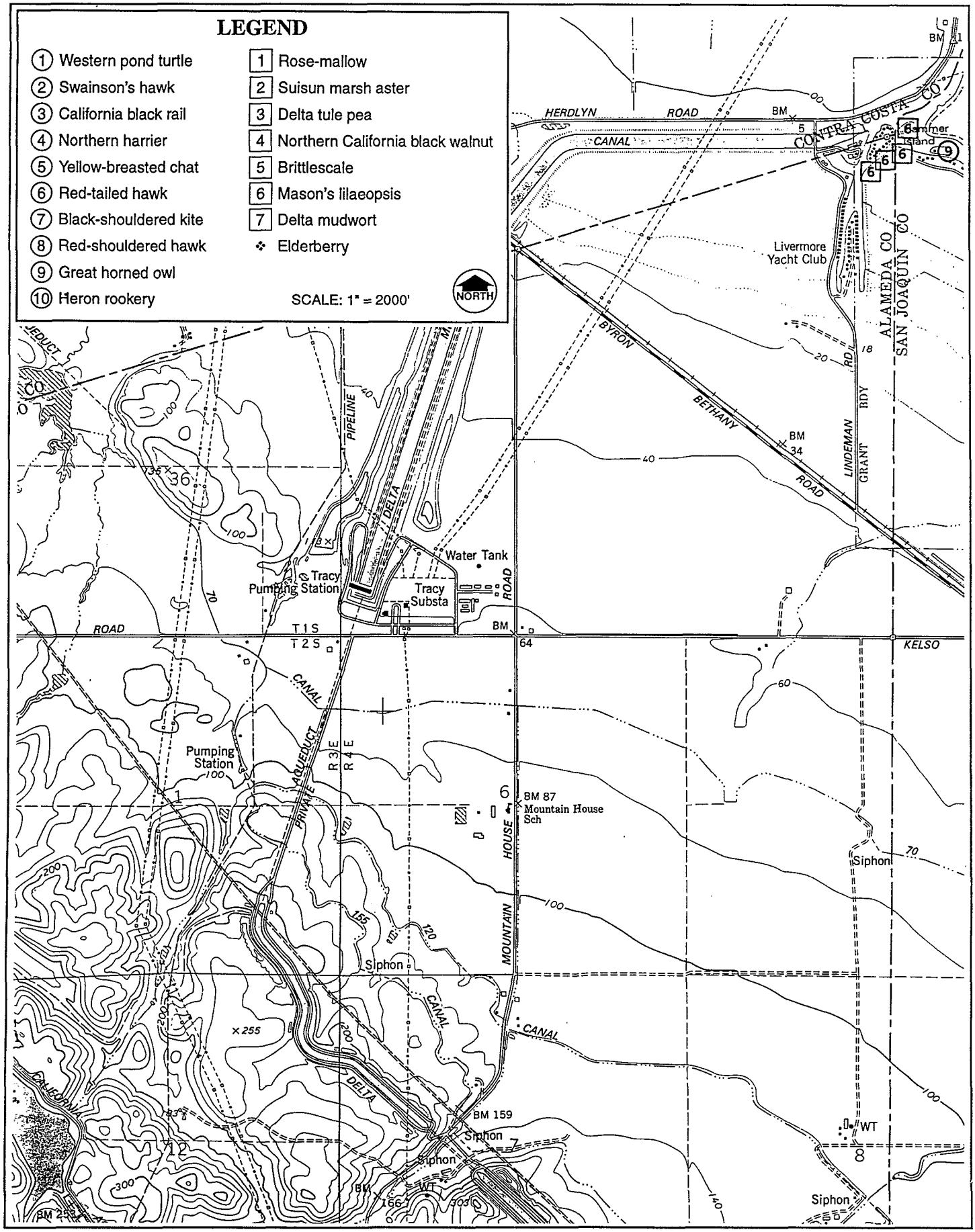

Figure A-13. Locations of Sensitive Species on the USGS Clifton Court Forebay 7.5' topographic quadrangle, center portion [Source: MGA 1994]

C-052536

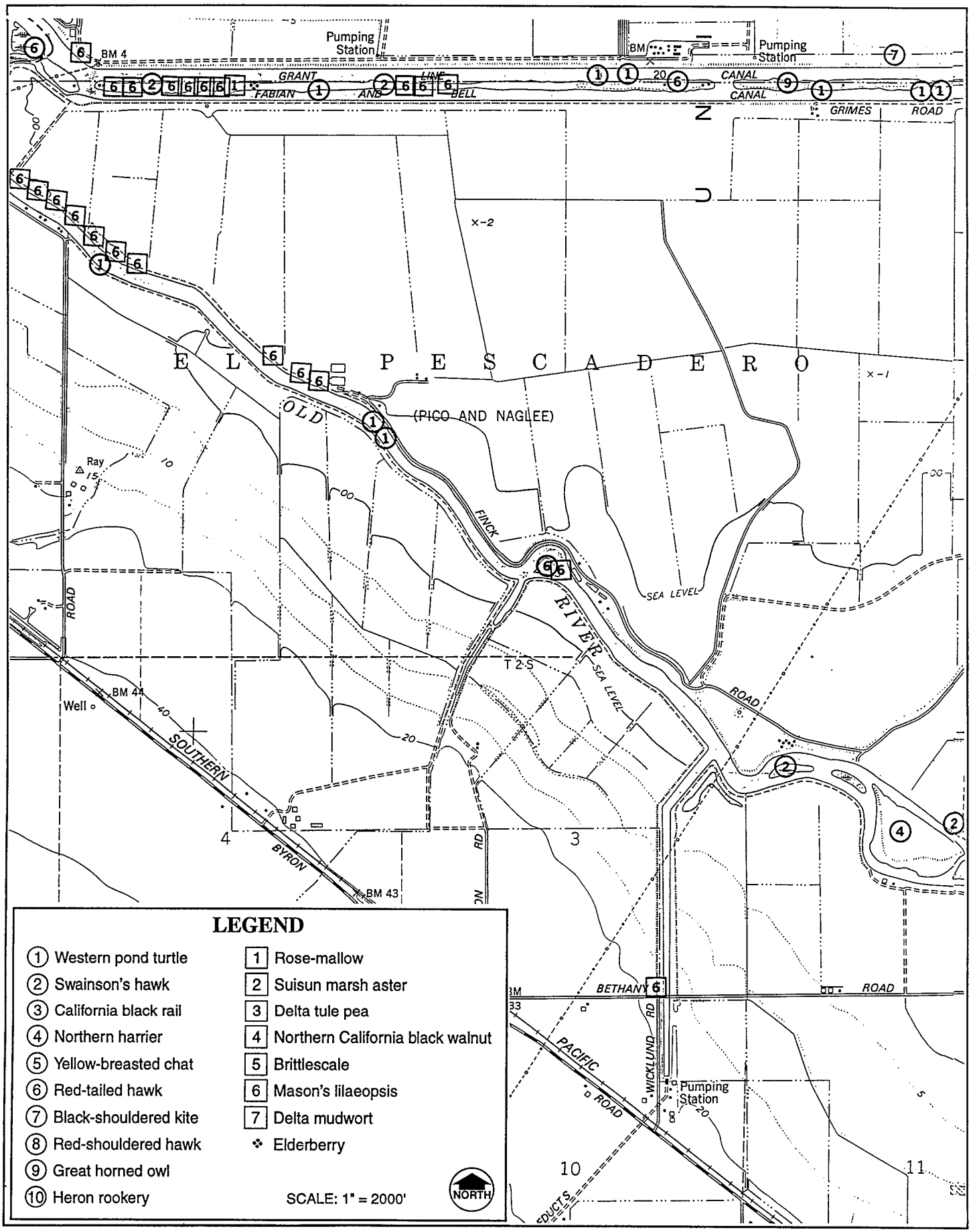

Figure A-14. Locations of Sensitive Species on the USGS Clifton Court Forebay 7.5' topographic quadrangle, SE portion [Source: MGA 1994]

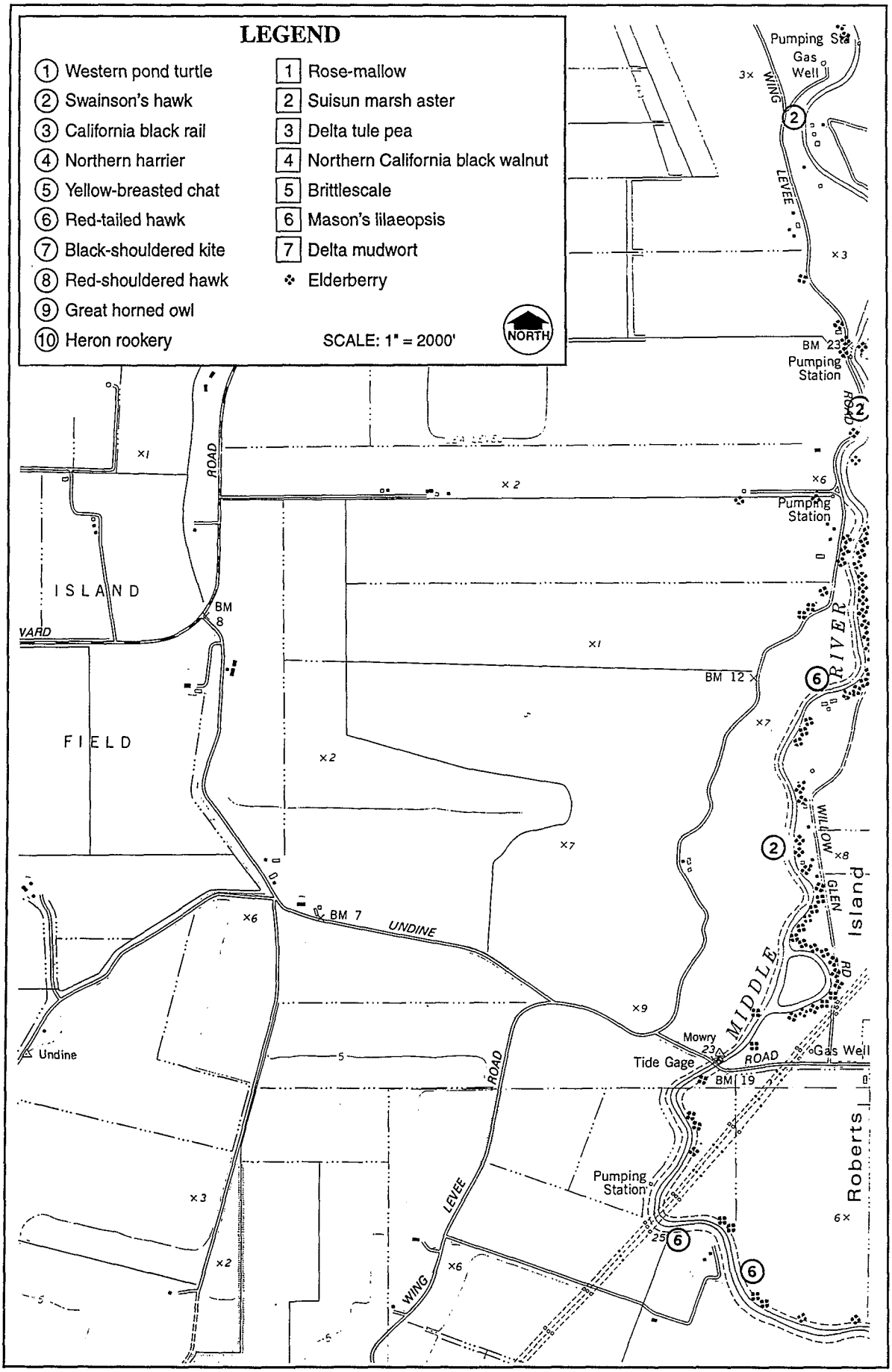

Figure A-15. Locations of Sensitive Species on the USGS Union Island 7.5' topographic quadrangle, NE portion [Source: MGA 1994]

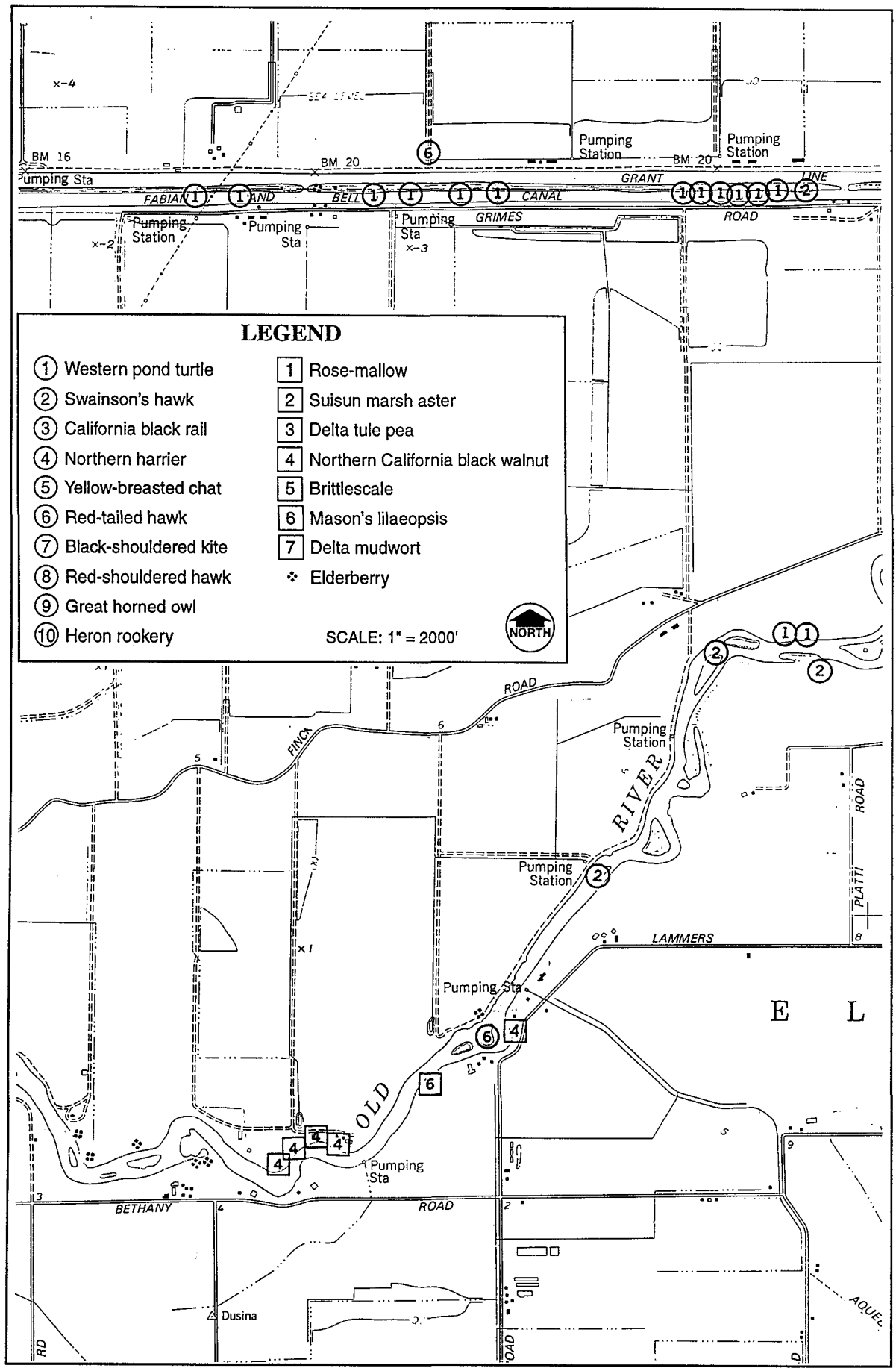

Figure A-16. Locations of Sensitive Species on the USGS Union Island 7.5' topographic quadrangle, center W portion [Source: MGA 1994]

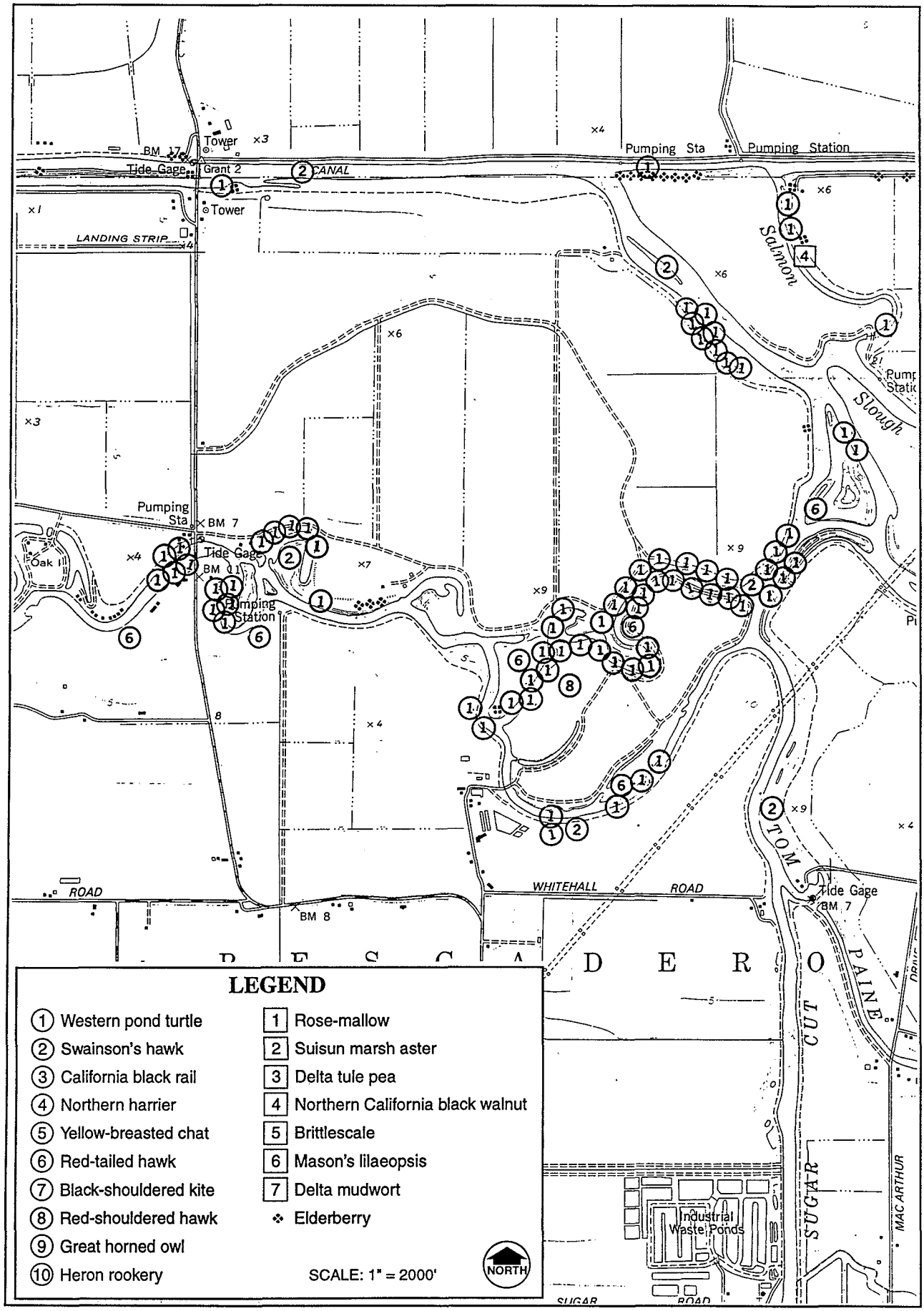

Figure A-17. Locations of Sensitive Species on the USGS Union Island 7.5' topographic quadrangle, center portion [Source: MGA 1994]

C-052540

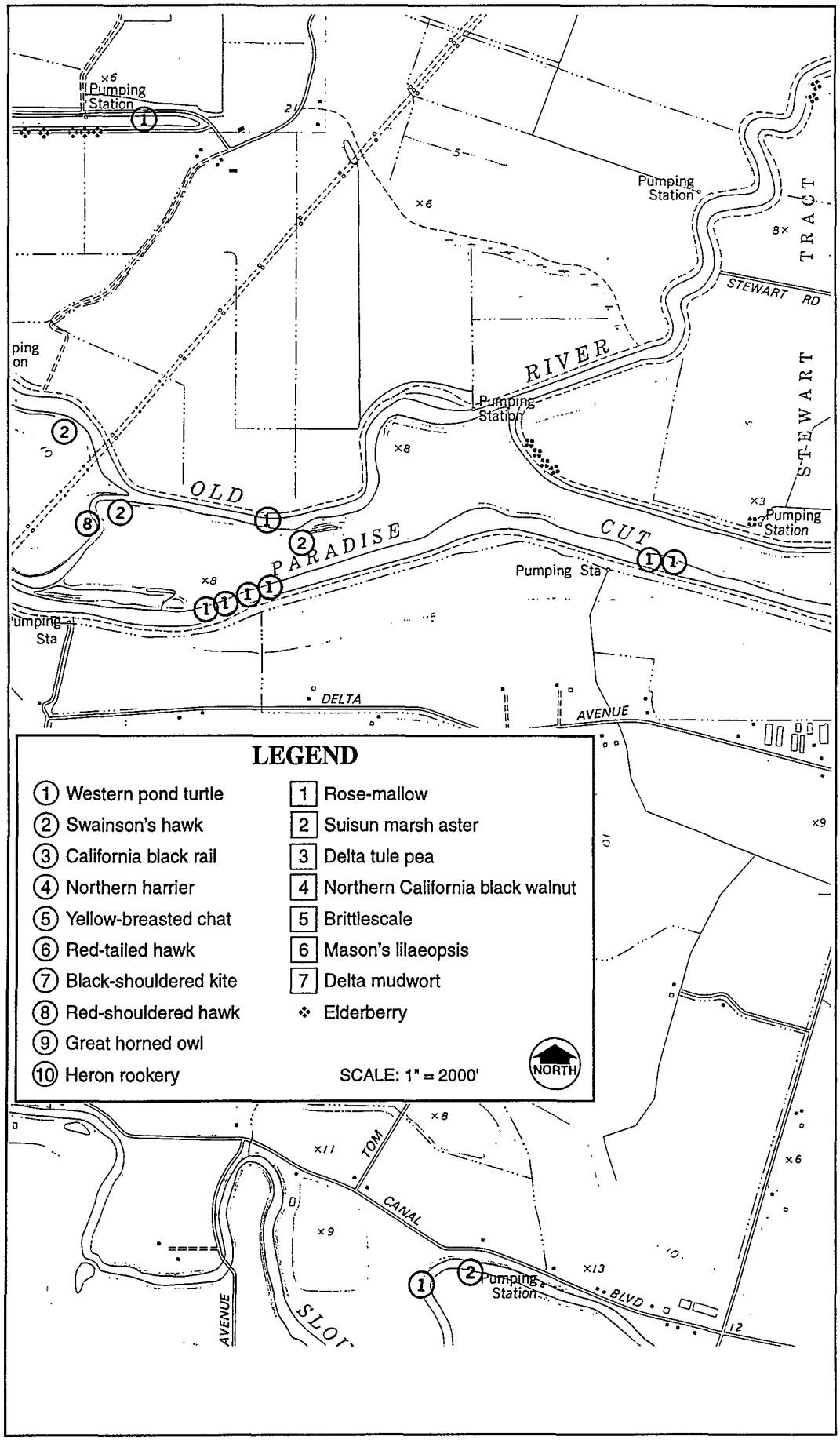

Figure A-18. Locations of Sensitive Species on the USGS Union Island 7.5' topographic quadrangle, SE portion [Source: MGA 1994]

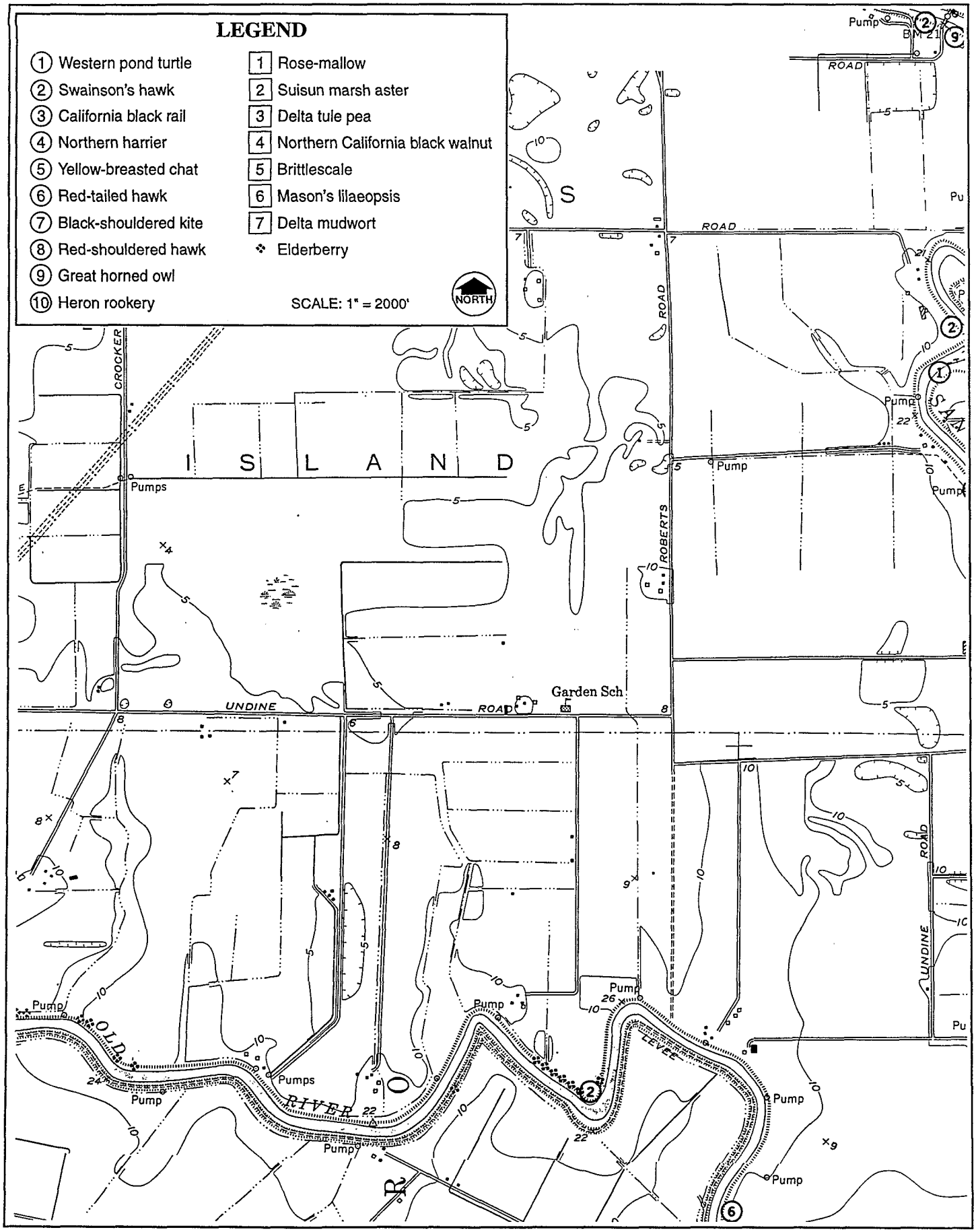

Figure A-19. Locations of Sensitive Species on the USGS Lathrop 7.5' topographic quadrangle, NW portion [Source: MGA 1994]

C-052542

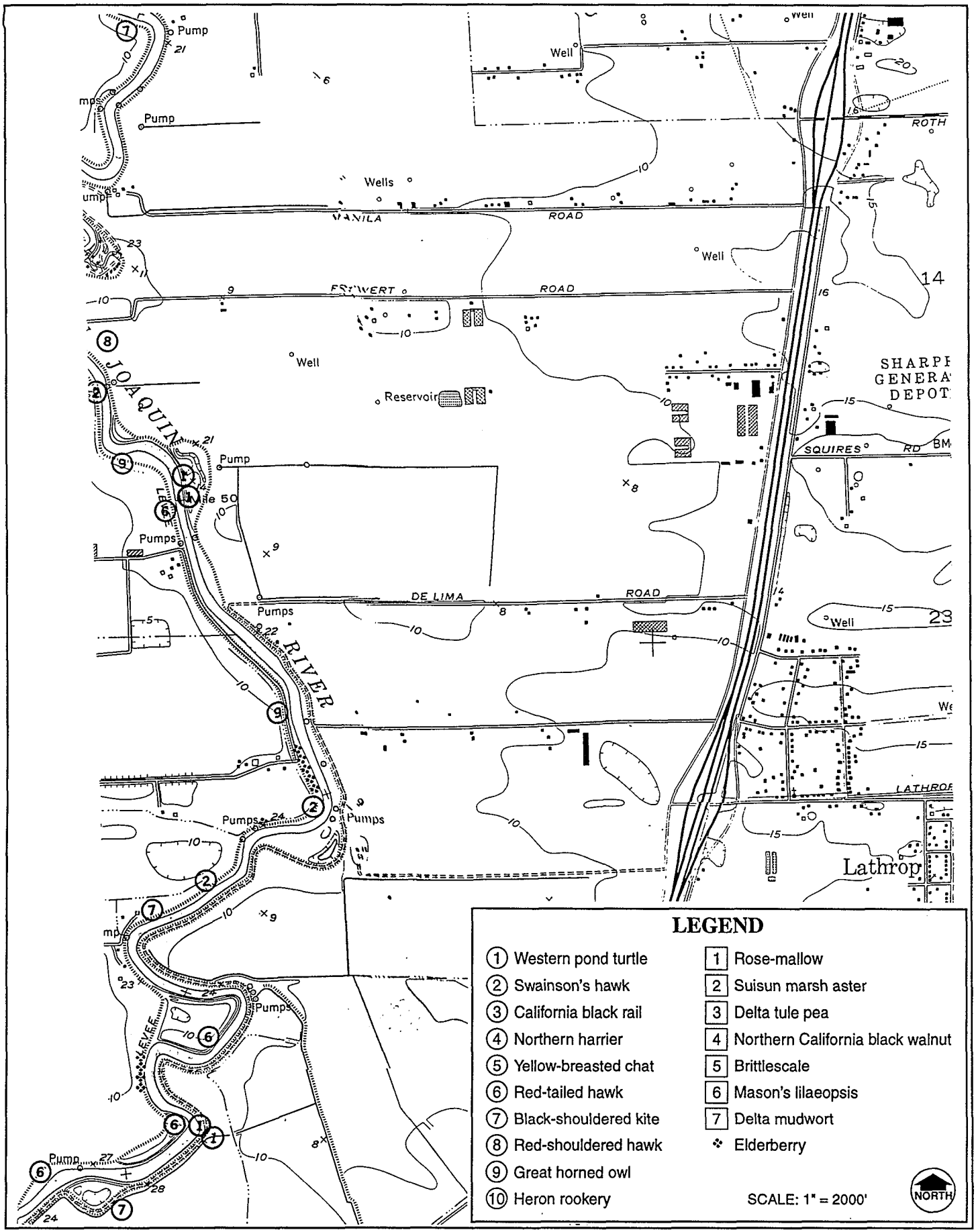

Figure A-20. Locations of Sensitive Species on the USGS Lathrop 7.5' topographic quadrangle, N center portion [Source: MGA 1994]

C-052543

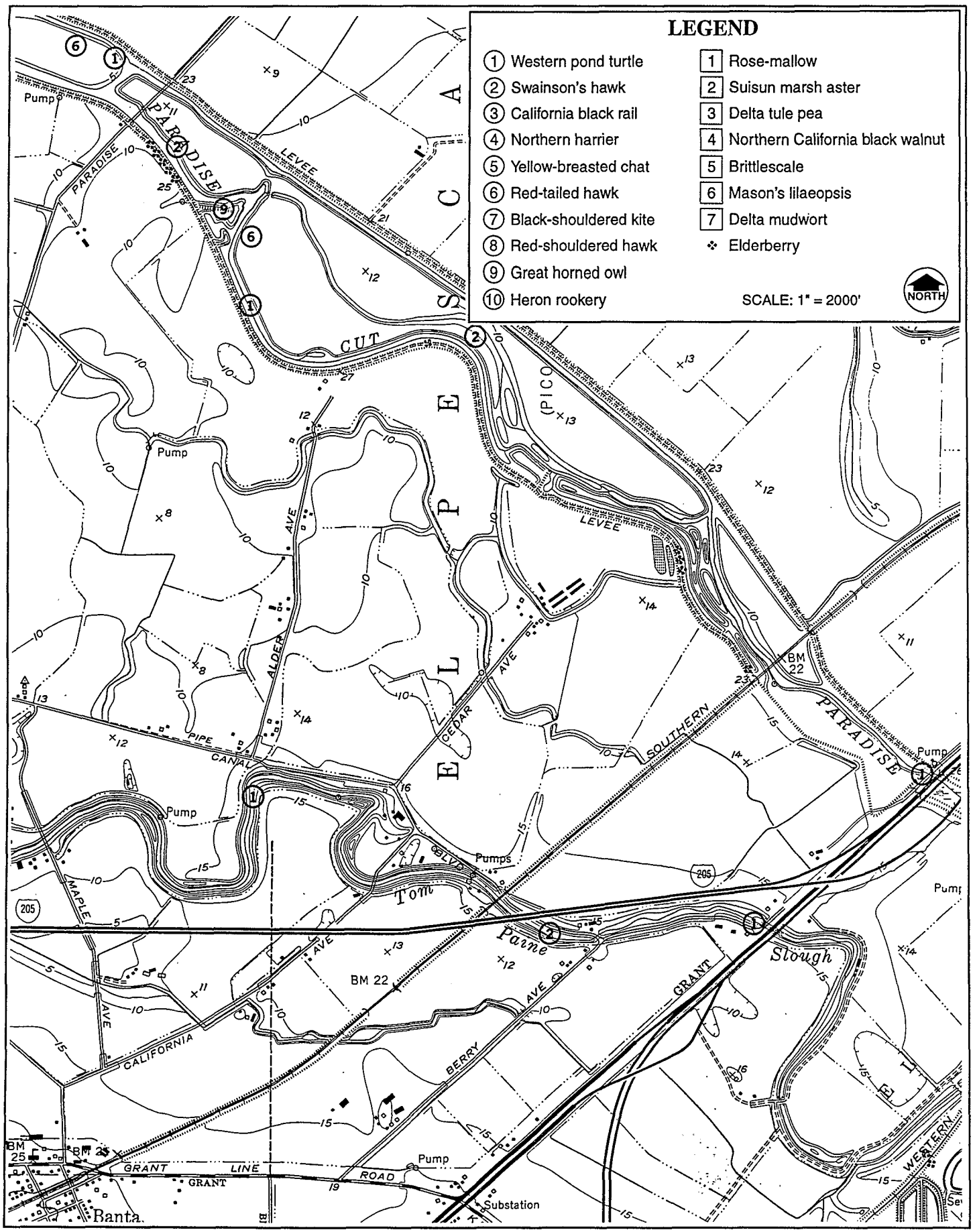

Figure A-21. Locations of Sensitive Species on the USGS Lathrop 7.5' topographic quadrangle, SW portion [Source: MGA 1994]

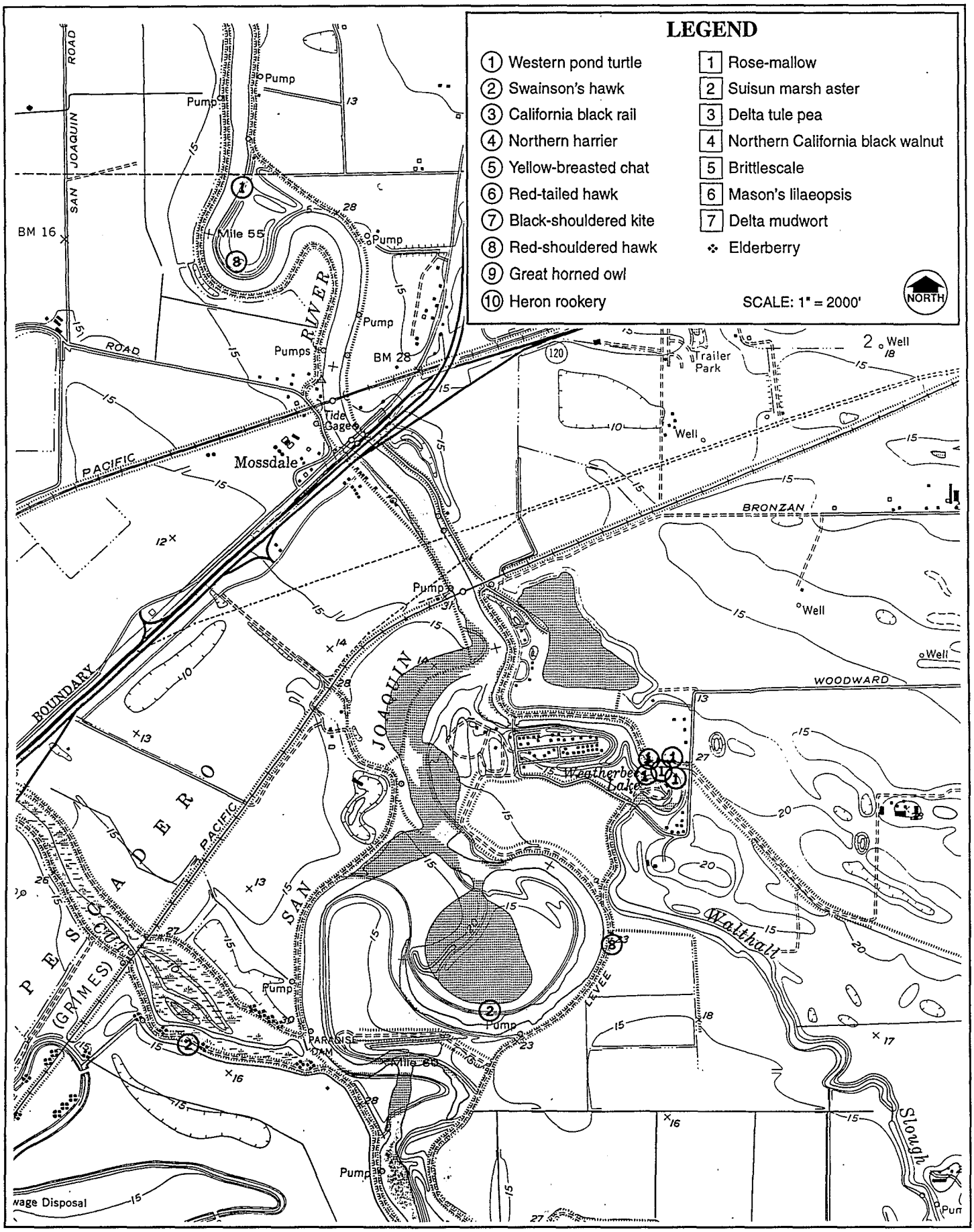

Figure A-22. Locations of Sensitive Species on the USGS Lathrop 7.5' topographic quadrangle, S center portion [Source: MGA 1994]